



BRILL

LANGUAGE DYNAMICS AND CHANGE 4 (2014) 1–51



brill.com/ldc

Bivalent Verb Classes in the Languages of Europe

A Quantitative Typological Study

■ in running headline, shortened title used. please check

Sergey Say

Institute for Linguistic Studies, Russian Academy of Sciences

St. Petersburg, Russia

serjzhka@yahoo.com

Abstract

The aims of this study are twofold: to propose methods for measuring (dis)similarities in the organization of valency class systems across languages, and to test them on a sample of European languages in order to reveal areal and genetic patterns. The data were gathered for 29 languages using a questionnaire containing 130 contextualized uses of bivalent predicates. The properties under study include (i) lexical range of transitives, (ii) lexical range of valency frames defined in terms of the “locus” of non-transitivity (whether A or P arguments are encoded by oblique devices), (iii) overall complexity of valency class systems, and (iv) lexical distribution of verbs among valency classes. In case of the simpler properties (i)–(iii), maps with quantified isoglosses and pairwise comparison of languages based on Hamming distance are used. For (iv) these methods are inapplicable (valency classes cannot be equated across languages), and I propose a distance metric based on entropy and pairwise mutual information between distributions. The distance matrices are analyzed using the NeighborNet algorithm as implemented in SplitsTree. I argue that more holistic properties of valency class systems are indicative of large areal effects: e.g., many western European languages (Germanic, Romance, Basque and some Balkan languages) are lexically “most transitive” in Europe. Low-level areal signal is clearly discernible in the data on more subtle aspects of the organization of valency classes. The findings imply that distributions of verbs into valency classes can develop quickly and are transferable in contact situations, despite drastic dissimilarities in argument-coding devices.

Keywords

valency classes – transitivity – languages of Europe – areal linguistics – quantitative typology

1 Introduction

Empirically grounded typological study of valency classes (classes of verbs with identical coding frames for arguments) is an intriguing and complex matter. It is complex for many reasons, starting with the lack of a clear basis for cross-linguistic comparison. For other areas of grammar there is some sort of consensus as to how the universal semantic space is structured, so the typological task is primarily to establish the ways in which individual language-specific categories and constructions carve out sections of that space. No consensus of this sort exists in the study of valency. There is a lot of controversy as to whether argument structure is primarily lexeme-based or construction-based, and whether and to what extent argument encoding is determined by abstract syntactic structure (“structural case”), by semantic roles of arguments, or by idiosyncratic lexical rules. Besides, valency is an area where grammar meets lexicon, and high dimensionality of possible lexical contrasts impedes simple qualitative comparison of languages. In other words, it is virtually impossible to classify valency class systems into a handful of categorical types, as is often done in other domains of linguistic typology. Provided that languages cannot be assigned to types based on qualitative analysis of their valency class systems, the task of finding typological similarities and differences in this domain calls for the use of quantitative techniques.

Yet, empirical study of valency classes in large samples of languages is urgently needed precisely for the same reasons. Typological empirical study is the only way to seriously test many hypotheses related to argument encoding, both very general (e.g., “argument encoding is determined by thematic roles of arguments”) and more specific (e.g., “the stimulus argument of emotive verbs can behave as either a cause-like or a goal-like argument”). Needless to say, as long as only individual languages are taken into consideration, such generalizations can be neither proved nor falsified. This paper is conceived as a step towards this end.

The goals of this study are twofold. The chief goal is methodological: to propose quantitative techniques that can be used for measuring the degrees of (dis)similarity in the ways languages arrange verbs into valency classes. The secondary goal is empirical: to apply these techniques to classes of bivalent

verbs in European languages and to unearth areal and genetic patterns in the data.¹

The data for this study have been gathered with the help of a questionnaire that contains contextualized uses of 130 bivalent predicates. Translational equivalents have been gathered for a convenience sample of 29 languages of Europe. For each language, the verbs obtained have been broken down into valency classes. All parts of this paper are concerned with comparing languages to each other with respect to their valency classes.²

Overall, there are four aspects of valency class systems that I analyze, ranging from simpler, more holistic properties to more complicated and fine-grained ones. These aspects are: (i) lexical extent of transitives; (ii) lexical extent of frames defined in terms of “locus” of non-transitivity, that is, based on whether A or P (or both) are coded by oblique (non-core) devices; (iii) overall complexity of valency class systems, and (iv) lexical distribution of verbs among valency classes as such.

Relatively simple techniques are used in cases (i) and (ii). First, I draw quantified isoglosses on the linguistic map of Europe to get an idea of where transitivity and (major subtypes of) non-transitivity are favored and disfavored. Second, I employ the relative Hamming distance for pairwise comparison of languages. The distance matrices are visualized with the help of the Neighbor-Net algorithm, as implemented in the SplitsTree software. In all these respects, the methods employed are typical for the current quantitative areal-typological research.

The results are indicative of large-scale areal trends: the highest ratios of transitive frames are observed in Western European languages (Germanic, Romance, Basque and some Balkan languages), a finding that confirms previous claims. These languages have low ratios of both frames with obliquely encoded A arguments (these are favored in Irish and the Daghestanian languages) and frames with obliquely encoded P arguments (these are most widespread in the languages of the eastern European periphery).

The technique I propose for measuring complexity of valency class systems (iii) is based on *entropy*. This measure captures the degree of unpredictability

¹ This paper is based on work in progress, and in some cases the data available will turn out to be somewhat scarce for anything but very preliminary generalizations with respect to this second goal.

² Another possible way of looking into the database is orthogonal: one can compare *verb meanings* in order to check whether they form natural clusters that recur in various languages, whether such clusters are semantically conditioned, etc. This perspective is to be pursued elsewhere.

of a variable. It is found to be lower in languages with higher ratios of transitive frames; this is expected, since in these languages more verbs fall into the largest class, that is, behave in the least unpredictable way. However, if one takes a closer look at non-transitive classes, it appears that there are numerous low-level areal and genetic discrepancies: languages that are close to each other areally, genetically and in terms of their transitivity profiles can drastically differ (in Dutch, for instance, non-transitive classes are fewer and larger than in the neighboring German).

As outlined above, simple methods are inapplicable when it comes to comparing lexical distributions of verbs among valency classes (iv), as there is no suitable *tertium comparationis*. Facing this methodological challenge, I propose a distance metric based on entropy and pairwise mutual information between distributions. This technique can be further used for studying valency class systems in other (e.g., non-European) languages and also for measuring (dis)similarities in other similar datasets, that is, whenever it is necessary to compare the ways in which languages break up pre-established objects into classes without equating the classes themselves.

Building a distance matrix based on the metric just outlined reveals low-level areal signal in the data. Smaller genetic groupings (such as branches of the Indo-European family) are discernible, but interestingly, local contact phenomena seem to be no less important. Large areal effects are, by contrast, less visible in the organization of individual valency classes than, e.g., in transitivity profiles.

Generally, the findings of this study confirm the idea that transitivity orientation and transitivity profiles are relatively stable properties of languages, but they also suggest that the structure of the verb lexicon in terms of individual valency classes can develop more or less independently of those devices that are used for coding arguments. Hence, we find low-level areal similarities and less diachronic stability.

The discussion below is organized as follows. Section 2 discusses advantages and disadvantages of possible approaches to typological study of valency classes and sets the ground for the study reported here. The procedure of gathering and annotating data from individual languages is described in Section 3. Sections 4 to 7 discuss results that were obtained when comparing the 29 languages of the sample with respect to transitivity (Section 4), “locus” of non-transitivity (Section 5), complexity of valency class systems (Section 6) and (dis)similarities in their internal organization (Section 7). Conclusions are summarized in Section 8.

2 Setting the Stage

In this section I will argue that transitive verbs constitute the only valency class of bivalent verbs that can be meaningfully equated across languages (that is, all other bivalent classes cannot). I will ultimately propose studying minor valency classes cross-linguistically by way of analyzing the whole *system* of valency classes, that is, the ways in which verbs with various meanings are grouped together in individual languages.

Among bivalent constructions, the (basic) *transitive* construction is the type of structure that figures most prominently in descriptive tradition, in functional-typological studies and in more formal approaches to argument structure.³ Whatever the definition of transitive construction—language-specific or typological—there is some general agreement as to what constitutes the semantic basis of transitivity. Starting with Hopper and Thompson's (1980) groundbreaking study, it has been assumed that there is a set of values of semantic parameters that is universally associated with high transitivity, including actionality (as opposed to stativity), telicity, volitionality and control of one participant (A), affectedness of the other (P), etc. Generally, such lists of properties are not viewed as necessary or sufficient conditions for transitivity of a clause, but it is agreed that clauses that accumulate more of those properties are likelier to be transitive than clauses that accumulate fewer of them. Variations on this theme can be found in abundant typological literature on the topic (Tsunoda, 1981; Wierzbicka, 1983; Dixon and Aikhenvald, 2000; Kittilä, 2002; Malchukov, 2006; Næss, 2007 etc.).

Although transitivity parameters are properties of clauses, in individual languages transitivity distinctions are largely inherent to verbal lexica—that is, normally there is a class of verbs that can be regularly found in the basic transitive construction, and these are viewed as transitive verbs. Within individual languages this prominent class is often hard to characterize in semantic terms, as it is usually an open class that encompasses many verbs (though not equally many in various languages) that are not highly transitive semantically, but nevertheless are treated on a par with genuine highly transitive verbs in the grammar. Thus, in English, for instance, it would be difficult to find a common semantic denominator for verbs like *leave*, *fear* and *presuppose*, which would set them apart from *arrive*, *look* and *consist*; and yet the former three verbs morphosyntactically pattern together with *kill* and *break* (the two verbs that

3 Suffice it to say that this type of structure is indispensable for any discussion of alignment type (Haspelmath, 2011).

are often quoted as being prototypical representatives of the transitive class), whereas the latter three do not.

Despite semantic versatility in individual languages, the class of transitive verbs can be relatively easily identified across languages (so long as we are able to identify the basic transitive construction). All other classes of bivalent verbs show the opposite properties: if compared to transitives, such classes are smaller and can often be either positively characterized in terms of their meanings, or represented as closed lists of lexical items. For example, in English there are only a few verbs that govern the preposition *from*, such as, e.g., *escape*, *recover*, *suffer*, or *benefit*; arguably, these verbs have common semantic properties (their object participant is related to a preceding state of affairs in the causal chain). However, such classes are very hard to identify across languages. This is exactly the reason why typological and theoretical studies often either ignore such classes or lump them together, describing them negatively as bivalent verbs that fail to be transitive for this or that reason.⁴

In this study, I propose to abandon altogether the idea of equating minor valency classes cross-linguistically and to concentrate instead on the ways individual items (verbs) are grouped into valency classes in the languages of the sample. In other words, the very structure of valency class systems, their internal organization, serves as a parameter for cross-linguistic comparison. What such a research program necessitates is that the database contain a substantial number of meanings, that these meanings be densely representative of the predicate lexicon (or its compact part, in our case), and that the meanings surveyed be indeed comparable across languages. These requirements are relevant for the design of the database, to be discussed in Section 3.

In the remainder of this section I will briefly overview other possible approaches to cross-linguistic study of non-transitive valency classes, highlighting concomitant complications and ultimately rejecting all of them.

4 For example, in Dowty's (1991) seminal study on proto-roles and argument selection, it is noticed in passing that "the selection principles apparently only govern argument selection for two-place predicates having a subject and a true direct object" (ibid.: 576), whereas principles that are operational when assigning arguments to other positions remain unmentioned upon. Another example is Tsunoda's (1981) idea that the occurrence of the transitive valency frame is related to what he calls "the effectiveness condition." One of Tsunoda's conclusions is that, when this condition is not met, the transitive valency frame may fail to occur and "we will have some other case frames" (ibid.: 393). Whether semantic conditions for these "other case frames" can be described positively is not discussed. See Malchukov (2005: 77) on problems triggered by non-differentiation of various non-transitive patterns in the literature.

(i) One way to compare classes of verbs cross-linguistically is to start with semantically defined classes, such as, e.g., experiential predicates (Bossong, 1998).⁵ Such studies greatly contribute to our understanding of possible meaning-to-form mappings and yield important areal and genetic generalizations. However, sets of meanings that are established on *a priori* semantic grounds can turn out to be irrelevant for delimitation of valency classes in individual languages.⁶

Another problem is that, when focusing on a particular type of predicates, one normally compares them to other pre-established types of predicate-argument structures that are viewed as “basic” and serve as standard of comparison. For example, Haspelmath (2001b), largely following Bossong’s (1998) proposal, distinguishes between agent-like, dative-like and patient-like experiencer constructions. Trying to rely upon basic meanings of predicate-argument constructions can lead to circularity when studying several valency classes simultaneously.

(ii) A possible way out of the circularity problem is relying on those “basic meanings” of argument-coding devices that belong to the domain of circumstantial relations, such as, e.g., locative adjuncts. We can, for instance, identify languages in which the second argument of ‘fear’ is coded by the device that is also involved in marking adjuncts with the meaning of ‘starting point’ of motion. Such an approach would be an enquiry into polysemy of argument coding devices (e.g., cases; see Ganenkov, 2002), and, ultimately, into paths of semantic development from more concrete to more abstract meanings (possibly as part of a wider grammaticalization process). Logically, such an approach is irreproachable. Empirically, however, it is also problematic for the cross-linguistic study of valency classes for at least three reasons. First, for many verb classes in various languages, it is synchronically impossible to find diachronic sources with ‘concrete’ meanings. Second, semantic change is a gradual and multiform process, and argument devices employing one and the same initial “cognitive schema” may show significant variation in their synchronic properties (e.g., the degree of abstractness they have acquired). Third, there are frequency problems: for example, a case can have a locative meaning on just a few circumstantials, and there seems to be no principled way to decide whether

⁵ Ultimately, it can be instructive to study the ways in which one particular predicate meaning is expressed across languages, cf. Stassen’s (2009) study of predicative possession.

⁶ The idea that case assignment patterns reveal evidence for universal predicate-specific thematic role clusters has recently been quantitatively assessed and seriously called into question (Bickel et al., forthcoming).

this locative meaning should nevertheless be counted as “basic” to other more abstract meanings.

(iii) Along with explicitly semantic approaches, there are some attempts at cross-linguistic comparison of valency classes based on equating individual forms, e.g., a class of verbs that take a nominative subject and a dative object. This kind of approach can be fruitful for the study of genetically related languages, where morphological devices can be identified based on historic evidence; see, e.g., a discussion of typologically rare case-frames in the branches of Indo-European in Barðdal (2014). However, once we take into consideration a wider range of languages, identification of individual cases is only an arbitrary semantics-based approximation; thusly understood, cases are descriptive categories and not comparative concepts—see Haspelmath (2010) for discussion. For example, van Belle and van Langendonck (1996) discuss dative cases in various languages, and for doing so make use of the notion ‘dativity’: “the meanings associated with the dative case in, for instance, Indo-European” (ibid.: xv). Such an approach bears in itself all the shortcomings of role-based studies of valency classes, see (i) above, and adds one more: it grants some special status to those combinations of meanings that happen to be grouped together in a number of better studied languages.

In (i)–(iii) above we have been discussing the problem of comparing individual classes of verbs across languages. Cross-linguistic identification is even more complicated when comparing overall systems of valency classes. In other areas of grammar, typologies of systems rely upon equating individual members; for example, we can typologize number systems into those possessing a grammaticalized category of dual and those lacking it. As follows from the discussion above, similar component-based typologies are problematic for valency class systems, as we do not have reliable tools for equating components of such systems. As a result, until recently,⁷ there was very little typological inquiry into

⁷ Recent advances in this area include at least two major research projects: a project conducted by Balthasar Bickel and his colleagues, see Bickel et al. (forthcoming), and the Leipzig Valency Classes Project (<http://www.eva.mpg.de/lingua/valency>), see Comrie and Malchukov (forthcoming). The design of the latter project is in some respects similar to that of the study reported here. Major differences are the following: (i) the samples used are comparable in size, but the Leipzig project is based on a world-wide sample; (ii) the Leipzig project is thought to cover all valency types of verbs, but the questionnaire is relatively small, and the number of bivalent predicates is significantly smaller than in the study reported here (40 odd vs. 130 verb meanings); (iii) the Leipzig project is primarily focused on valency alternations.

the ways valency class systems are organized.⁸ This study is intended to partially redress this lacuna.

3 Database

This section discusses the technicalities related to gathering data for the project. Section 3.1 describes the questionnaire and the role of language experts involved in the project. 3.2 introduces the notion of “locus of non-transitivity” that was relevant for annotating the database. Some typical complications that we encountered when gathering the data are briefly analyzed in 3.3. The sample of languages is introduced in 3.4.

3.1 Questionnaire

This study is based on a questionnaire consisting of 130 sentences that contain bivalent predicative expressions. In the default case, the initial data for each language were gathered and annotated by a language expert who elicited translations from native speakers (the details and deviations from this procedure are discussed in 3.4). Currently, the questionnaire exists in Russian, English and French versions, as these three languages were used as contact languages when working with native speakers of other languages.

In most cases the target sentence was given in a context, as shown in parentheses in the following examples (N. stands for a personal name):

- (1) (The wall was covered with fresh paint.) *N. touched the wall* (and got dirty).
- (2) *N. shot at the bird.* (He missed.)

Thus, for example, when gathering translations for (2) we were not seeking to obtain sufficiently precise equivalents of the English verb *shoot* as such, but, rather, to get sentences in which arguments are semantically related to the predicate in the same way as in (2).

The use of contextualized clauses, not just isolated verbs, is essential for several reasons. Most importantly, it makes cross-linguistic comparison more accurate. Indeed, the meanings of individual verbs can be structured differently in various languages, so that lexical translational equivalents often have only

⁸ Some in-depth analyses of valency class systems in individual languages are available, e.g., Levin (1993) for English or Apresjan (1967) for Russian.

partial semantic overlap. Providing contexts mitigates this problem, since sentential translational equivalents usually match better than lexemes. Another advantage is that providing contexts often reduces variation in argument realization, cf. ungrammaticality of the transitive use of *shoot* in (2). Finally, it allows us to obtain data on argument-coding even if the target language lacks a verbal equivalent. For example, many languages lack a specialized verb for 'have,' but there must be a way to express the meaning 'N. has a car.'

In the discussion to follow, the meanings surveyed will be referred to as 'predicate meanings,' or simply 'predicates.' For the sake of simplicity, English verbs, such as *touch* or *shoot*, will be used as labels for individual predicate meanings, but what is implied is always a particular contextualized meaning from the questionnaire. Verbal expressions that correspond to predicate meanings in individual languages will be referred to as 'verbs,' again for the sake of simplicity (some expressions obtained are complex, rather than simple verbs, see 3.3 for details).

The sentences in the questionnaire all have (at least) two nominal dependents, that is to say, the study is focused on the ways in which these pairs of arguments are coded in various languages.⁹ To compare the ways in which verbs cluster into valency classes, a sufficiently large and dense set of predicates was needed. Covering all types of numeric valency in one questionnaire would have led to a set of predicates either too huge or too distorted. Two-argument predicates were chosen because in most languages they fall into several classes, whereas one-argument verbs, for instance, rarely fall in more than two or three classes and in some languages constitute a single monovalent class.¹⁰

The final assembly of the questionnaire followed scrutiny of the available literature on two-argument non-transitives and a pilot study of several languages. The study was designed to be primarily focused on non-transitive patterns, because these patterns are less predictable (and hence more informative) than

9 In fact, the issue of argumenthood is language-specific, so that there are no *a priori* grounds to guarantee that a translational equivalent of an argument in language A is also an argument (not adjunct) in language B. However, this study did not deal with this issue: so long as the two pre-established nominals could be expressed as verb's dependents in the target language, it was their encoding that was registered. For the sake of simplicity, the two nominals are referred to as arguments (one can expect predicates like 'resemble,' 'see' or 'touch' to have two arguments each), although it was not checked whether they indeed meet criteria of argumenthood in the languages at issue.

10 Some of the meanings surveyed are arguably three-argument predicates, but these were analyzed based on devices involved in coding their two predefined arguments; e.g. for 'take,' the sentence was *P. took a book* (from the shelf).

transitive patterns. For this reason, when choosing the predicates for the questionnaire, we tried to represent as widely as possible various meanings that do not accumulate too many prototypically transitive properties and/or were known to be expressed by non-transitive verbs in at least some languages of Europe, such as, e.g., 'be afraid,' 'be similar,' 'see,' 'reach,' 'fight (with),' 'wait,' 'depend,' 'play (musical instrument),' 'like,' 'lack' etc.; see Onishi (2001: 25–35) for an overview, albeit under a theoretically different perspective. The questionnaire also contains sentences that can be expected to deviate from the transitive case-frame in some languages because of their contextualized meaning. This is the case, e.g., with the conative use of *shoot* in (2) above: it is known that in many languages (including English) the non-attainment of the goal can result in using a non-transitive valency frame with this verb, and this was the reason why this context was preferred to other possibilities when compiling the questionnaire.

However, several highly transitive meanings ('eat,' 'break,' 'wash,' 'write') were also included, but they were expected to serve mainly as predictable background for less transitive meanings. The questionnaire, in its slightly simplified version, can be found as supplementary material to this paper at <http://dx.doi.org/10.1163/22105832-00401003; booksandjournals.brillonline.com/content/22105832> (click on tab Supplements). ■ changed to add and removed parentheses ok?

The arguments of the predicates were annotated as A and P arguments based on their "lexical entailments" in the sense of Dowty (1991). In some cases this procedure was unproblematic. In 'N. punished his son,' for example, the punisher is unequivocally identified as A, since it is the causing and volitional participant that has some degree of control over the other participant, P. In other cases the annotation was somewhat arbitrary. In 'The bucket filled with water,' for instance, the container was labeled A, and the substance, P, although in fact both entities have some (but not all) properties typically associated with A: the water is more of a causing entity, but the bucket is more of an independently existing entity. However, these decisions presumably did not affect the results too severely, as they were taken prior to gathering data and thus independently of the valency frames observed. ■ please note that the 1st link is not available yet, the 2nd link to Brill's online platform is available

Once the translations were obtained, language experts annotated the sentences for those morphosyntactic devices that were used for coding A and P arguments. These devices include dependent-marking, head-marking, detached marking and linear position. On this stage, it was important to figure out which of these possible devices are indeed involved in argument marking. Consider the following example from Albanian:

- (3) *Pjetr-it* *i* *dhimbs-et*
 P.-DAT.M.SG.DEF PRO.DAT.3SG cause.pity-PRS.INACT.3SG
nën-a *e* *tij*
 mother-NOM.F.SG.DEF ART.NOM.F.SG his
 'Pjeter sympathises with his mother.'

Here, the A argument happens to be in the preverbal position and the P argument in the postverbal position. However, word order is generally independent of valency in Albanian, and it was not considered to be one of the argument marking devices. The A argument is encoded by the dative case (dependent-marking), which is echoed by the preverbal dative clitic (detached marking), whereas the P argument is in the nominative case (dependent-marking) and triggers agreement on the verb (head-marking). Combination of these devices unequivocally identifies the valency frame observed in (3).¹¹

The next step was to identify verb classes. Two verbs were considered to belong to the same valency class if and only if their AS and PS are coded by the same means correspondingly (different adpositions being counted as different encoding devices). Thus, for instance, the Albanian verb in (4) is classified as belonging to a different class than the one in (3), as here it is the A argument that is in the nominative, whereas the P argument is in the dative:

- (4) *Pjetr-i* *i* *beso-n* *Lindit-ës*
 P.-NOM.M.SG.DEF PRO.DAT.3SG believe-PRS.ACT.3SG L.-DAT.F.SG.DEF
 'Pjeter believes Lindita.'

Following this procedure, translational equivalents of the 130 sentences were grouped into non-overlapping classes, with each class characterized by a unique combination of devices involved in coding A and P arguments. For example, there are five other predicates whose Albanian equivalents belong

¹¹ An interesting feature of the European languages analyzed in this paper is that, in fact, there was not a single case such that two valency frames would employ identical dependent marking devices (cases and/or adpositions) but would differ in terms of detached or head-marking. Hence, for practical reasons it was possible to conventionally label valency frames in terms of dependent-marking devices only. Thus, the pattern in (3) can be characterized as "A in the dative, P in the nominative" frame; the fact that A is echoed by a clitic, and P triggers agreement, follows automatically according to the rules of Albanian grammar. This simplification has no impact on the results obtained for the languages of the sample, but certainly it would be illegitimate for languages that make wider use of head-marking devices.

to the same A-dative, P-nominative class as the verb in (3): ‘lack,’ ‘like,’ ‘need,’ ‘have left’ (as in *N. has 10 Euros left*) and ‘dream.’

The language experts sometimes used additional data when identifying valency frames. For instance, if the noun from the questionnaire happened to lack a case distinction found in other nouns or in pronouns, the valency class was established based on the encoding of those other NPs that do exhibit the relevant case distinction. However, modification of sentences was only allowed for identification of coding devices, whereas behavioral or control distinctions between identically coded arguments were disregarded.

Some typical problems encountered when analyzing the data are briefly discussed in 3.3.

3.2 *Transitivity and Locus of Non-transitivity*

Once the list of valency frames in a language is established, it is essential to identify the transitive frame. There is some controversy regarding criteria to be used. Criteria that rely upon language-specific forms (e.g., “verbs governing the accusative case”) as well as approaches that make use of “structural cases” are not very useful in typological research. Putting them aside, we still have a wide spectrum of existing proposals, which include identifying the class of transitive verbs as (i) the largest and most productive bivalent class, (ii) the “default” class, that is, the bivalent class that is the least constrained semantically (this criterion is not always easy to implement practically), (iii) the class which is most closely associated with high transitivity values in Hopper and Thompson’s (1980) sense, (iv) the class that contains some predefined lexical items such as ‘kill’ or ‘break.’ A short comparison of these approaches can be found in Bickel et al. (in prep.).

Although theoretically these criteria may not converge upon the same class, in practice there was not much confusion with respect to the languages in the sample. For example, in all languages of Europe surveyed so far, ‘break’ (which is included in the questionnaire) belongs to the class that was identified as transitive by the other criteria (and by traditional descriptions). As indicated by the language experts, for some languages there are also language-specific syntactic criteria that single out transitive verbs as opposed to all bivalent non-transitive verbs (e.g., passivizability).

Thus, for every language, we identified language-specific morphosyntactic devices that are employed for coding A and P arguments of transitive verbs. In Lithuanian, a fairly typical language with accusative case marking, the A argument of the transitive verb is marked for the nominative case and triggers verb agreement, whereas the P argument appears in the accusative case:

- (5) *Lok-ys užpuol-ė žvej-į*
 bear-NOM.SG attack-PST.3 fisherman-ACC.SG
 'A bear attacked a fisherman.'

The coding devices that are used for A and P in the basic transitive construction are viewed as *direct*. All other types of argument coding devices are considered *oblique*. If either A, P, or both arguments receive oblique coding, the relevant arguments are viewed as the *locus of non-transitivity* (sometimes simply referred to as *locus* in the following discussion). Accordingly, all bivalent non-transitive verbs were annotated as showing A locus, P locus or A&P locus.¹² This can be illustrated by further examples from Lithuanian: the verb in (6) is classified as showing A locus of non-transitivity, because here the A argument is in the dative case (oblique), whereas the P argument is in a direct position (it is coded identically to A of the basic transitive construction); (7) is an instance of P locus, as here it is only the P argument that is in an oblique position (it is encoded by a prepositional phrase headed by *nuo* 'from'); (8) illustrates A&P locus, as both A and P receive oblique coding (the dative and the genitive case respectively).

- (6) *Petr-ui patink-a šit-ie marškini-ai*
 P.-DAT.SG please-PRS.3 this-NOM.PL shirt-NOM.PL
 'Petras likes this shirt.'

- (7) *Petr-as atsilik-o nuo Marij-os*
 P.-NOM.SG fall.behind-PST.3 from M.-GEN.SG
 'Petras fell behind Marija.'

- (8) *Petr-ui pakank-a pinig-ų*
 P.-DAT.SG suffice-PRS.3 money-GEN.PL
 'Petras has enough money.'

Notice that annotating a verb as showing, e.g., A locus does not imply that its P argument is coded identically to P arguments in the transitive construction. In (6) above, for example, the P argument is in the nominative case, like

¹² The very rarely observed "reversed" valency frame (e.g., A in the accusative and P in the nominative) is not identified as transitive in the usual sense, although both arguments are in direct positions. These cases were somewhat arbitrarily annotated as valency frames with A locus.

A arguments of transitive verbs. The reason for treating such constructions as constructions with A locus (not A&P locus) is that the nominative coding of the P argument can be viewed as triggered by A's failure to occupy that position—cf. Malchukov's "Primary argument immunity principle," which predicts that manipulating the case marking of the primary argument (A/s in accusative languages, s/P in ergative languages) is normally accompanied by the "ascension" of the other argument (2006: 340 ff.). This principle is not exceptionless, as indicated by attested instances of A&P locus and examples like (9), again from Lithuanian, where oblique coding of the A argument combines with the usual accusative coding of the P argument:

- (9) *Petr-ui skaud-a galv-q*
 P.-DAT.SG ache-PRS.3 head-ACC.SG
 'Petras has a headache.' (A locus)

Similarly, verbs with P locus, that is, with oblique marking of the P argument, can put their A arguments in either of the two direct positions, cf. the ERG-DAT and ABS-DAT frames in Basque, both classified as frames with P locus.

3.3 *Missing Data and Typical Complications*

The procedure of gathering and annotating data was not unproblematic. In this section I briefly mention some typical complications, especially those that triggered gaps in the database.

Some gaps were due to the fact that there simply was no natural way to express the intended predicate meaning in a given language.

Other gaps appeared if the translations obtained failed to meet the following requirements: the clause is headed by a verb or another sufficiently unified predicative expression, and the predefined A and P arguments are syntactically realized as clause-level dependents of this expression. According to this restriction, if one of the predefined arguments couldn't be specified in the translation (a situation that sometimes arose with, e.g., P arguments of verbs of emotion) the monovalent verb at issue was filtered out.¹³

¹³ This is an inevitable disadvantage of all meaning-based approaches to comparing valency, as numeric valency is language-specific and cannot be guaranteed on *a priori* grounds; see Comrie (1993: 906, 911) on possible mismatches in numeric valency of translational equivalents. In our database there were also verbs that required a third argument in certain languages, although initially they were viewed as two-place predicates.

A more widespread complication comes from constructions where one of the predefined arguments is expressed in the same clause but is not a clause-level constituent, as in the following examples from Lezgi:

- (10) *Mehamed-an qʔil tʔa-zwa*
 Mehamed-GEN head.ABS ache-IMPF
 ‘Mehamed has a headache.’
- (11) *zi θil-er-iqʰaj benzin-din ni qwe-zwa*
 my hand-PL-POSTEL gasoline-GEN smell.ABS come-IMPF
 ‘My hands smell of gasoline.’

In (10) the expected A argument of the predicate is syntactically realized as P’s possessor. In (11) the expected P argument is syntactically the possessor within the noun phrase headed by *ni* ‘smell.’ In both cases, the problematic arguments are adnominal rather than clause-level, and accordingly both constructions were filtered out.¹⁴

It should not be inferred, however, that only clauses headed by true monolexemic verbs were annotated. Many clauses headed by complex predicates of various sorts (including what is sometimes analyzed as “light verb constructions” and “serial verb constructions”) were taken into account. For instance, such not quite verbal clauses are abundant in Irish:

- (12) *Chuir Pól piniós air a mhac*
 put.PST P. punishment on his son
 ‘Pól punished his son.’

14 The reason for doing so is the following. The project is largely aimed at testing the hypothesis that case-frames are determined semantically, that is, predicates that are similar semantically assign their respective arguments to identical positions. In examples like (11), by contrast, there is no predicative expression that can be claimed to simultaneously assign coding devices to ‘hands’ and ‘gasoline.’ The two relevant noun phrases are assigned their syntactic positions differently: the noun for ‘hands’ is in the postrelative case due to the properties of the verb *qwe-* ‘to come,’ similarly to the starting point in some verbs of motion. This fact does tell us something about the way the situation of smelling is construed in Lezgi. By contrast, ‘gasoline’ is encoded identically to all nominal possessors (cf. ‘branch of a tree,’ ‘mother’s heart,’ ‘Mehamed’s car’ etc.) and this fact has little to do with the situation of smelling as such.

- (13) *Tá aithne aige Pól air Máire*
 be.PRS knowledge at P. on M.
 'Pól knows Máire.'

Such expressions were not filtered out, because in both cases predefined A and P arguments can be arguably viewed as clause-level dependents. Of course, there is no watertight borderline between cases like those in (10) and (11), on the one hand, and (12) and (13) on the other hand, but this topic is not to be pursued here any further, for limitations of space.

A very widespread complication arises when a sentence from the questionnaire could be translated in more than one way, with possible differences in argument encoding (on average, there were about 12 predicates per language for which there was variation in valency frame, although this figure varies considerably from language to language). For quantitative purposes it was necessary to choose one construction, albeit somewhat arbitrarily. The chief criteria were naturalness and preciseness of translational equivalence to the stimulus, followed by monolexemy of the predicate (so that *ceteris paribus* simplex verbs were preferred to more complex expressions).

Finally, the main concern when annotating the data was to discern valency frames lexically associated with verbs (or verbs used in a particular meaning) and to discard the impact of grammatical rules. For example, for languages showing differential object marking, the verbs that are able to take marked P arguments were all classified together regardless of whether individual sentences that were obtained happened to contain a marked or an unmarked object. This problem was taken into account when assembling the questionnaire (there were no negated, counterfactual, habitual etc. sentences). However, there was some unwanted “noise” in the data and the language experts inevitably had to face the usual problem of squeezing the somewhat blurred distinctions into the set of discrete annotations.

3.4 *Sample*

This paper is based on the analysis of data from 29 languages of Europe, 28 living and one extinct (Ancient Greek). Europe is understood here in the vein of the EUROTYPE series of volumes, that is, very broadly (with, e.g., the languages of the Caucasus taken into account). The languages surveyed are represented in Table 1.

The sample in its current form is largely accidental, as its enlargement depends upon availability of enthusiastic language experts. There are several unfortunate areal and genetic lacunae, most notably Ugric and Samoyedic, Northwest Caucasian, Kartvelian and Nakh languages.

TABLE 1 *Language sample*

Family	Genus	Language	Abbreviation	Expert	
Isolate		Basque	bsq	Natalia Zaika	
Indo-European	Celtic	Irish	iri	Dmitrij Nikolaev	
		Romance	Spanish	spa	Elena Gorbova
			Italian	ita	Anna Alexandrova
			French	fre	Elena Kordi
	Germanic	English	eng	Dmitrij Nikolaev	
		Dutch	dut	Mikhail Knjazev	
		German	ger	Sandra Birzer	
	Greek	Norwegian Bokmål	nor	Olga Kuznecova	
		Ancient Greek	gra	Ildar Ibragimov	
		Modern Greek	grk	Ekaterina Zheltova	
	Albanian	Albanian	alb	Varvara Diveeva	
	Baltic	Latvian	lat	Natalia Perkova	
		Lithuanian	lit	Natalia Zaika	
	Slavic	Serbian	scr	Anastasia Makarova	
		Polish	pol	Georgij Moroz	
		Russian	rus	Sergey Say	
	Armenian	Eastern Armenian	arm	Vasilisa Krylova	
	Iranian	Ossetic	oss	Arsenij Vydrin	
	Indic	Romani (Kalderaš)	rka	Kirill Kozhanov	
Uralic	Finnic	Estonian	est	Irina Külmoja	
		Ingrian	fng	Daria Mischenko	
		Komi-Zyrian	kzy	Ekaterina Sergeeva	
(Altaic)	Turkic	Bashkir	bsk	Sergey Say	
		Azerbaijani	aze	Lejla Kurbanova	
Northeast Caucasian	Mongolic	Kalmyk	kmk	Sergey Say	
		Lezgian	lez	Ramazan Mamedshaxov	
		Tsakhur	tsa	Dmitrij Gerasimov	
	Avar-Andic- Tsezic	Bagvalal	bgv	Dmitrij Gerasimov	

Deviating from the general procedure, in three cases there was no access to native speakers and the data were gathered from published sources; these are Tsakhur, Bagvalal, and, naturally, Ancient Greek.¹⁵ In the case of German, Russian, Estonian, Lezgi and Azerbaijani, the language experts were simultaneously linguists and native speakers and used their own introspection. The experts on Ingrian, Bashkir, and Kalmyk were typologists who conducted fieldwork on the respective languages. In the case of Dutch and Norwegian, the experts were also typologists who happened to have some skills in respective languages. All other experts have years of experience of working on the grammar of the respective languages and speak them fluently. For those languages for which corpora are available, they were sometimes taken into consideration when choosing the most natural or frequent equivalent.

Finally, in four cases the level of missing data was significantly higher than average for non-linguistic reasons: Tsakhur (satisfactory data only obtained for 55 predicates), Bagvalal (65), Estonian (89) and Kalmyk (98). Thus, in some aspects the data for these languages had to be disregarded.

4 Transitive and Non-transitive Verbs

In this section, I compare the ratios of transitives to all bivalent verbs and show that the main areal pattern in Europe is a cline from the highly transitive languages of Western Europe to less transitive languages in the European periphery (4.1). In 4.2, I compare the very sets (not their sizes) of predicates that are transitive in individual languages, and build a distance matrix of languages based on pairwise comparisons. Not surprisingly, the highly transitive languages of Western Europe are generally close to each other in this matrix, but there are also some more granular trends discernible in the data. This means that areally proximate languages are likely not only to have

15 In the case of Tsakhur and Bagvalal, the sources used were grammars that contain valency lexicons and glossed texts: Kibrik (1999) and Kibrik (2001) respectively. For Ancient Greek, the expert mostly searched texts available in the Perseus Digital Library (<http://www.perseus.tufts.edu>). In both cases it was virtually impossible to find exact equivalents of the necessary sentences, so experts were looking for contexts with similar meanings. The valency frames were included in the database if the expert was relatively confident that the same frame would also be possible in a translation of the sentence from the questionnaire.

comparable transitivity ratios, but also to assign similar sets of predicates to their transitive classes.

4.1 *(In)transitivity Ratio*

When comparing languages of the sample we will generally proceed from simpler and more holistic properties towards computationally more complex and fine-grained characteristics. It is natural to start with the simplest measure that can be extracted from the database: the proportion of transitive verbs out of all verbs registered for an individual language (e.g., for Albanian this ratio is $0.52 = 67/128$). The relevant data can be found in the “Tr” column of Table 5 in the Appendix.

The ratio of transitives calculated in this way can be viewed as a correlate of a language’s inclination towards transitivity. A remark of caution is necessary, however: the absolute value of this measure is rather meaningless, as it is fully dependent upon the arbitrary choice of predicates to survey.

One facet of this problem is that languages for which the data are largely missing cannot be directly compared to other languages in terms of this ratio. For example, among the 55 verbs that were gathered for Tsakhur, there were 30 transitives. The ratio calculated on this basis, 0.55, puts Tsakhur rather high on the overall ranking (11th among the 29 languages). However, this does not seem to reflect its real rank. Indeed, if we compare languages based on these 55 predicates only, the rank of Tsakhur would be only 26th, that is, it would be qualified as one of the “least transitive” languages. Similar problems were also encountered for two other languages with scarcer data, Bagvalal and Kalmyk. The transitivity ratios for these three languages (parenthesized in Table 5) are disregarded in the subsequent discussion.

Under the reservations just discussed, the transitivity ratio can nevertheless serve as a useful basis for typological comparison, if viewed as a relative value and only for those languages in which comparable sets of data have been obtained.¹⁶ The ratio of transitivity in the languages of the sample has a broad range of values: from 0.34 for Lezgi to 0.67 for Modern Greek, which allows

16 Even when viewed in this way, this measure can still be somewhat arbitrary: our 130 predicates, as any other set of predefined lexical items, cannot be claimed to be representative of the bivalent verbal lexicon in general. It can be imagined that (non-)transitivity values beyond this set of 130 predicates typologically pattern differently from what is observed in this study. This is, however, the usual and largely inevitable problem in lexically-based typology. The reader is advised to mentally add a modification like “For at least those 130 predicates studied ...” to whatever conclusion is presented below.

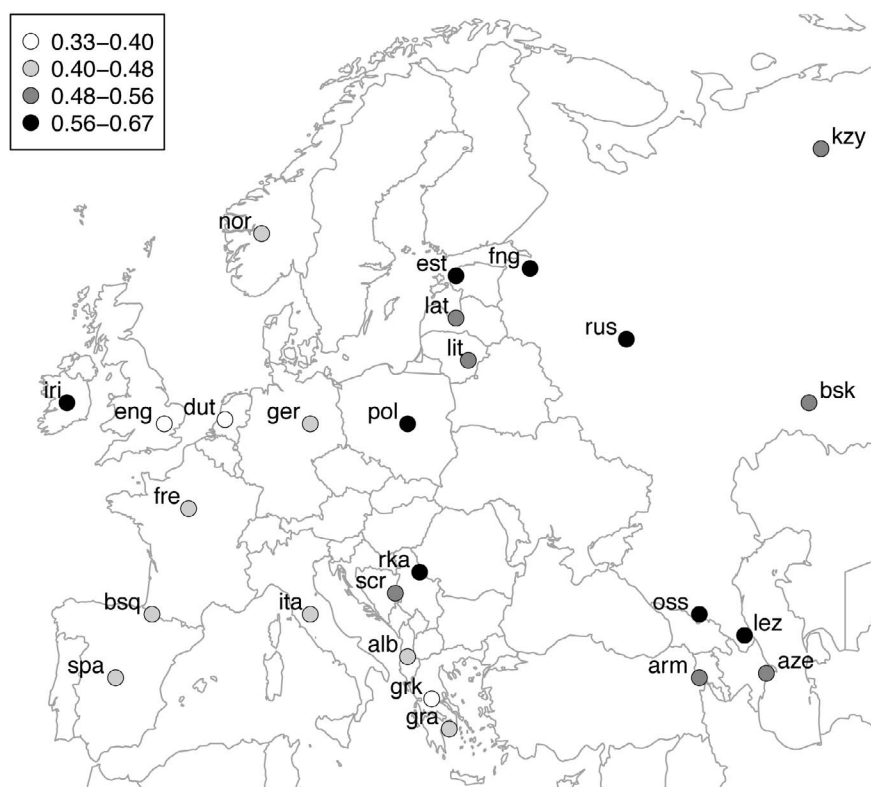


FIGURE 1 *The ratio of non-transitives in the languages of Europe*

tracking cross-linguistic variation in the languages of Europe. Importantly, despite all coarseness of this measure, it also shows a clear areal pattern, as can be seen in Fig. 1.¹⁷ For the sake of visual comparability with the maps to follow, Fig. 1 represents *non-transitivity* ratios.¹⁸

The European languages with the highest ratios of transitives are: Romance, Germanic, both Modern and, to a lesser extent, Ancient Greek, Albanian and Basque. The peaks of non-transitivity are observed in the languages spoken to

17 All maps in this paper, as well as the diagram in Fig. 6, were created by Maria Ovsjannikova using R (R Core Team, 2013) with the additional packages ‘rworldmap’ (South, 2011) and ‘calibrate’ (Graffelman, 2006).

18 The geographical position of the dot for Kalderaš Romani (symbolized “rka”) is somewhat arbitrary and follows convention in Haspelmath et al. (2005). The data for this variety were obtained from Kalderaš Romas living near St. Petersburg, Russia, whose ancestors migrated from Romania in the 19th century.

the south and east of the Baltic Sea, and also Lezgi, Ossetic and Irish, with the remaining languages falling in between the two extremes.¹⁹

Thus, the “high transitivity area” comprises most languages of western Europe (with the exception of Irish), plus languages of the south-western Balkans. This set can be compared to the so-called Standard Average European (SAE) languages, a somewhat fuzzy set of languages that have the highest numbers of typical European linguistic features (that is, features that are less frequently attested in other parts of the world). Thusly understood, SAE languages are often thought to constitute the linguistic core of Europe (Haspelmath, 1998, 2001a; van der Auwera, 2011; see also a critical overview in Heine and Kuteva, 2006: 1–30).

A widely-cited list of defining SAE properties has been proposed by Haspelmath (2001a). It includes 12 features: 1) definite and indefinite articles, 2) relative clauses with relative pronouns, 3) ‘have’-perfect, 4) nominative experiencers, 5) participial passive, 6) anticausative prominence, 7) dative external possessors, 8) negative pronouns and lack of verbal negation, 9) particles in comparative constructions, 10) relative-based equative constructions, 11) subject person affixes as strict agreement markers, 12) intensifier-reflexive differentiation.

A striking similarity between the “high transitivity area” and the SAE core is evident if one compares the map in Fig. 1 above with the map that summarizes Haspelmath’s findings on the “degrees of membership in SAE” (Haspelmath, 2001a: 1505).²⁰ The set of languages with transitivity ratios above 0.52 (that is, non-transitivity ratios below 0.48, cf. Fig. 1) fits nicely with the area on

19 The idea of quantitative typology based on lexical range of the transitive construction was sketched by Drossard (1991). It was built on a list of ten *a priori* defined semantic types of predicates (“effect,” “pursuit,” “attitude,” “similarity,” etc.), so that the binary values (transitive vs. non-transitive) were somehow defined for the whole type. Drossard examined six languages, including four European languages that were shown to form a hierarchy (English > German > Russian > Avar) from more to less lexically transitive (1991: 435). Despite drastic differences in technicalities, this hierarchy is echoed in the results reported here.

20 The isopleths shown in Haspelmath’s map are based on a 9-member subset of the 12 features listed above (with features 4, 6 and 9 disregarded). The data are the following: French, German (9 features); Dutch, Spanish, Portuguese, Sardinian, Italian, Albanian (8 features); English, Romanian and (Modern) Greek (7 features); Icelandic, Norwegian, Swedish, Czech (6 features); Hungarian, Latvian, Lithuanian, Polish, Russian, Ukrainian, Slovene, Serbian/Croatian, Bulgarian (5 features); and then Breton, Basque, Maltese (2 features); Welsh, Georgian, Armenian (1 feature); and finally Irish, Finnish, Estonian, Nenets, Komi, Udmurt, Tatar, Lezgi(an), and Turkish with no SAE features.

Haspelmath's map covered by languages with 6 or more SAE features (with one notable exception, to be discussed immediately). Notice that the only SAE feature that could have some logical connection with our data, Haspelmath's No. 4 "nominative experiencers," is not taken into account in his map (see Section 5 for further details on "nominative experiencers").

The notable exception mentioned above is Basque. With respect to Haspelmath's SAE features, it behaves as a fairly marginal SAE language (2 features), whereas its transitivity ratio (0.56) is quite high and very close to the figures obtained for two neighboring Romance languages, French (0.56) and Spanish (0.59).

Another important difference between the two sets of data is the structure of the eastern European periphery. With respect to Haspelmath's features, the Baltic and most of the Slavic languages, all with 5 SAE features, are SAE languages (although to a lesser extent than the core SAE languages listed above) and contrast sharply with European languages further to the east, including Finnic, which show no SAE features at all. With respect to transitivity, the picture is completely different: Russian, Polish and, to a lesser extent, the Baltic languages are among the "least transitive" languages, and in this respect pattern together with Finnic. All these languages are thus part of the eastern European low transitivity area, which also includes Ossetic, Kalderaš Romani and Lezgi.

Moreover, arguably it is this eastern European low transitivity area (transitivity ratios between 0.33 and 0.44) which stands out against a wider areal background, whereas the transitive western European languages (transitivity ratios between 0.56 and 0.67) might be more typical languages of Eurasia.²¹ The data obtained for several non-European languages of Eurasia are obviously too scarce, but preliminarily favor this hypothesis: the transitivity ratios for Arabic (0.61), Japanese (0.54), Nanai (0.60), Chukchi (0.59), Khmer (0.74) and Mandarin Chinese (0.81)²² are all much higher than in most eastern European languages of the sample.²³ The figures obtained for three Turkic languages, two within the European sample, Azerbaijani (0.48) and Bashkir (0.46), and one outside it, Tuvan (0.47), are intermediate between values observed in east-

21 This idea is consistent with J. Nichols' finding (pers. comm.; see also Nichols et al., 2004), on the distribution of causativization and decausativization in the languages of the world.

22 The data for these languages have been gathered and analyzed by Ramazan Mamedshaxov, Yukari Konuma, Daria Mischenko, Maria Pupynina, Sergey Dmitrenko and Elena Kolpachkova respectively.

23 These figures are in discord with the very tentative suggestion by Lazard (1994: 63) that languages of Europe employ the basic transitive schema more widely than many other languages of the world and may even be viewed as "un type extrême" in this respect.

ern European languages and in the Asian languages listed above. This result matches the intermediate geographic position of Turkic languages and thus corroborates the overall pattern.

The transitivity ratio as such is an aggregate measure that results from interaction of other, more atomic properties, which are partly discussed below. There is, however, at least one general grammatical property which strongly correlates with non-transitivity ratios, namely, the size of the case inventory for nouns (shown in the “Cases” column of Table 5 in the Appendix; Pearson’s $r = 0.65$; the data for Kalmyk, Bagvalal and Tsakhur are disregarded).²⁴ The correlation is strong (Pearson’s $r = 0.53$) even if we additionally disregard languages with no case in nouns at all (Romance, Norwegian Bokmål and Dutch).

An important question is whether there is a causal link between the two properties, or they just happen to be similarly patterned in Europe: case inventories are known to show an east-to-west decline in Europe (Lazard, 1998: 106–107). The former hypothesis is not improbable. Languages with richer case systems, by definition, have a wider inventory of more grammaticalized tools available for flagging oblique arguments without resorting to adpositions, which generally tend to be semantically more specific and syntactically heavier (Luraghi, 1991: 66–67; Hagège, 2010: 37–38). It is thus natural to expect that such languages may make use of these economic options with wider sets of verbs.

Although plausible, this hypothesis clearly needs areally non-biased verification. Interestingly, even in Europe there are several points of divergence between the two areal patterns. Basque, for instance, has a very rich case inventory, which is not typical of western European languages, but in terms of its transitivity ratio it is similar to surrounding languages, as discussed above. On the other hand, whatever remnants of the Indo-European case system there are in Irish, they are not relevant for marking arguments of non-transitive bivalent verbs; and yet, Irish is among Europe’s “least transitive” languages.

4.2 *Transitivity Profiles*

Obtaining comparable values for transitivity ratios does not itself imply any similarity in the way languages treat individual predicate meanings, even with respect to transitivity. It can thus be instructive to study languages’ “transitivity profiles”: the sets of predicates that are assigned to the transitive class. The

²⁴ A. Malchukov (pers. comm.) hypothesizes that this correlation is part of a still wider correlation, namely, between non-transitivity ratios and dependent-marking. This hypothesis cannot be properly tested within the sample discussed in this paper, as there are no languages in this sample that consistently favor head-marking.

TABLE 2 (Non-)transitive verbs: Eastern Armenian vs. Azerbaijani and Norwegian Bokmål

		Azerbaijani		Norwegian Bokmål	
		Transitive	Non-transitive	Transitive	Non-transitive
Eastern Armenian	Transitive	53	8	51	10
	Non-transitive	5	53	15	46

problem with transitivity profiles is that it is difficult to capture their properties holistically for purposes of cross-linguistic comparison. However, they are suitable for pairwise comparison of languages: for every predicate meaning, we can check whether corresponding verbs have identical (in)transitivity values in a given pair of languages. Table 2 contains the results of comparing Eastern Armenian to two other languages: Azerbaijani and Norwegian Bokmål.²⁵

The degree of dissimilarity in pairs of languages can be captured by the relative Hamming distance: the proportion of predicates with non-identical transitivity values (transitive in one language, non-transitive in the other) out of all predicates that have been obtained for both languages. E.g., Eastern Armenian's relative Hamming distance to Azerbaijani is 0.11 (= 13/119), and to Norwegian Bokmål, 0.20 (= 25/122). Thus, although the three languages are quite close in terms of overall transitivity ratios, with respect to assigning predicate meanings to the transitive class, Eastern Armenian is much closer to Azerbaijani than to Norwegian Bokmål.

Based on this technique we can build a distance matrix for the languages of the sample. For the analysis and visualization of distance matrices, I applied the NeighborNet method, as implemented in the SplitsTree4 software (Huson and Bryant, 2006).²⁶

NeighborNet allows to represent distances faithfully in large sets of "taxa" (languages, in our case) on a plane, which is achieved by way of splitting the paths. It should be noted that visual proximity of labels is irrelevant; what matters is the length of the route between the nodes along the edges of the

25 Only those predicates are tabulated for which satisfactory data were gathered in both languages compared. Thus, the sums of values in the two parts of the table are not identical.

26 A fundamental advantage of this method is that it simply disregards gaps in the data. Consequently, Fig. 3 and other splits graphs below represent all languages of the sample, regardless of the number of verbs obtained.

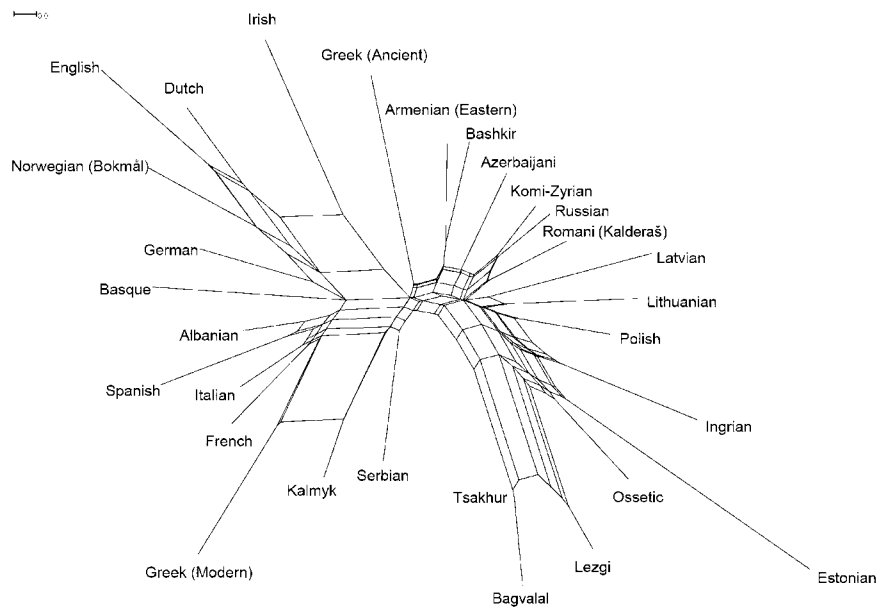


FIGURE 2 (Dis)similarities in transitivity values of predicates meanings (NeighborNet visualization)

graph. An important aspect of “reading” the NeighborNet visualization is tracking splits represented by sets of parallel edges of equal length. For example, in Fig. 2 there is a remarkable split represented by 8 almost horizontal edges in the left part of the graph. The languages to the left of this split are exactly the highly transitive languages discussed above, with the exception of Ancient Greek. Somewhat impressionistically, we can thus conclude that Romance, Germanic, Albanian and Modern Greek are not only “comparably transitive,” but also “similarly transitive,” whereas Ancient Greek is “comparably transitive,” but stands out from this group in terms of its transitivity profile.

Unlike classical taxonomic trees, the NeighborNet method allows partial overlaps between sets of “taxa.” In Fig. 2, for instance, there is a split that sets Irish, Dutch and English apart from all other languages—a set which can be indicative of an areal signal. This set overlaps (Dutch, English) with the set of highly transitive languages discussed above, but Irish clearly does not belong to that highly transitive group.

There are some small groupings discernible in Fig. 2 which can be interpreted genetically (cf. Daghestanian, Baltic and to some extent Germanic) or areally (cf. discussion of Irish above). However, the overall impression is more indicative of large-scale areal patterns. Most notably, the horizontal dimen-

TABLE 3 *Distribution of patterns in terms of locus*

	Label	P: core		P: non-core		
		No.	%	Label	No.	%
A: core	Transitive	1658	49.8	P locus	1469	44.1
A: non-core	A locus	167	5.0	A&P locus	38	1.1

sion in Fig. 2 roughly corresponds to geographical longitude, which is largely accounted for by the decrease of the transitivity ratio from west to east. Other areal patterns include an opposition between northern and southern areas among the highly transitive languages (with Basque standing apart) and the tightly-knit group of languages from Europe's north-east in the upper right-hand part of the graph. These languages do not form a real cluster, but are characterized by low distances between them.

5 Deviations from Transitivity: A and P Locus of Non-transitivity

In this section, I will discuss (dis)similarities between European languages based on their use of non-transitive frames with oblique marking of A (A locus) or P (P locus); simultaneous oblique marking of A and P will be shown to be very rare (5.1). Frames with A locus of non-transitivity will be shown to be most frequent in the Daghestanian languages and Irish, almost non-attested in other languages in the Northwest of Europe, and moderately present elsewhere (5.2). Frames with P locus are more frequent than frames with A locus throughout Europe and are particularly common in the European Northeast. The two geographical patterns are generally independent of each other (5.3). Languages with comparable frequencies of frames defined in terms of locus do not necessarily use these frames with similar sets of predicates: similarity of predicate sets defined in terms of locus is more common among areally and genetically proximate languages.

5.1 *Non-transitivity and Locus*

The four-way classification of verbs—non-transitive verbs with A, P and A&P locus, and transitive verbs—is built upon two defining properties that are logically independent of each other: for A and P to be either a core argument or not. The overall distribution of valency frames in the sample, according to these parameters, is shown in Table 3.

Valency frames with P locus of non-transitivity are much more frequent in the database than valency frames with A and A&P locus. Whether this is mostly determined by the choice of predicates,²⁷ or an areal property of European languages, or a universal trend cannot be deduced from the data.²⁸

As can be seen in Table 3, valency frames with A&P locus are the least frequent among the four types. Moreover, valency frames with A&P locus are attested less frequently than would be expected if oblique marking of A and P arguments were independent ($\chi^2 = 62.8$, $p \ll .001$): in fact, A is likelier to be coded as a direct argument if P is coded as an oblique argument, and the other way around.²⁹ Based on the overall rarity of A&P locus, it will be arbitrarily lumped together with A locus in 4.2 (see Lazard, 1994:146 for a similar approach, although in different terms).

The next question to ask is whether there is any correlation between ratios of frames with A and P locus. To apply correlation tests to actual percentages of frames with A and P locus (as shown in Table 5, see Appendix) is a misleading procedure, because these values represent frequencies of mutually exclusive types in the overall distribution. A legitimate question to ask is if there is a correlation between the ratio of verbs with A locus in a given language and the proportion of verbs with P locus *among the verbs without A locus* in that language. For the languages of the sample, at least, the answer is negative (Pearson's $R = -0.06$, $p = 0.75$). Hence, the two phenomena are more or less

27 The distributions obtained are of course dependent on the choice of predicates for survey, as locus of non-transitivity is to a large extent iconically motivated; cf. Malchukov's (2006: 335) "Relevance principle" predicting that deviations from transitivity (e.g., non-volitionality of A or non-affectedness of P) be usually marked on the "relevant constituent." See also Malchukov (2005) for a detailed discussion of how verbs differ with respect to favoring A vs. P locus.

28 The data in Bickel et al. (in prep.), which have been gathered from available descriptions for a world-wide sample of languages, imply that "non-default case assignment" is attested with P arguments more frequently than with A arguments, though the skewing in their distribution seems less sharp than in our data. "Non-default case assignment" is very similar to the notion of "locus of non-transitivity" as employed here; the major difference is that the former notion also covers direct (not oblique) encoding of an argument if it is different from the default. Thus, for example, the "A in the dative, P in the nominative" frame in a language that has accusative case will be viewed as having "non-default case assignment" for both arguments by Bickel et al., but it will be classified as a frame with A locus only in this study.

29 Tsunoda (1981) puts forward the "Unmarked case constraint" that captures the dispreference against patterns with A&P locus, almost to the point of ruling them out altogether.

independent of each other. They will be discussed in turn, starting with less frequent valency frames with A locus.

5.2 *Areal and Genetic Patterns in A Locus of Non-transitivity*

There are at least two types of phenomena related to A locus whose areal distribution in European languages is relatively well known. The first is the distinction between “generalized” and “inverted” strategies of encoding experiencers (Bossong, 1998; Haspelmath, 2001b). In the former strategy, the experiencer is morphosyntactically assimilated to agents (*I like it*), in the latter strategy it is assimilated to patients or goals (*It pleases me*). Bossong (1998: 287) identifies the part of Europe where the generalized strategy prevails as “l’Europe maritime,” which includes Scandinavian, Basque, English, most of Romance, Modern Greek, Bulgarian, Turkish and a few other languages. Haspelmath, after slightly shifting the cut-off point at the gradual scale, arrives at the conclusion that prevalence of “nominative experiencers” is one of defining features of SAE languages (see 4.1. above); the relevant map, entirely based on Bossong’s data, can be found in Haspelmath (2001a: 1496).

The second is the expression of predicative possession. Stassen (2009), in his worldwide survey, shows that “a major concentration” of the transitive strategy (“have-possessives”) “is found in the languages of western and south-eastern Europe: Germanic, Romance, West and South Slavonic, as well as Albanian, Modern Greek, and Basque feature this type as their unique encoding option” (ibid.: 247).

In both “generalized” experiential predicates and “have-possessives” the A argument is canonical, while their alternatives are for the most part valency frames with A locus as defined here. The possibility that these two typological features may be non-accidentally correlated in Europe is explicitly mentioned by Haspelmath (2001a: 1495).

In the 130-predicate list employed in this study, there are many experiential predicates as well as several verbs related to possession (not only ‘have,’ but also ‘lack,’ ‘need,’ ‘have enough,’ which often pattern together with ‘have’). Thus, the distribution of valency frames with A locus in our data was expected to subsume the distributions discussed above. The relevant figures can be found in Table 5 (see Appendix), while the map (with A and A&P locus lumped) is shown in Fig. 3.

By far the highest frequencies of valency frames with A locus are observed in Irish and the three Daghestanian³⁰ languages of the sample. The fact that the

30 The three Daghestanian languages are the only languages in the sample with strong

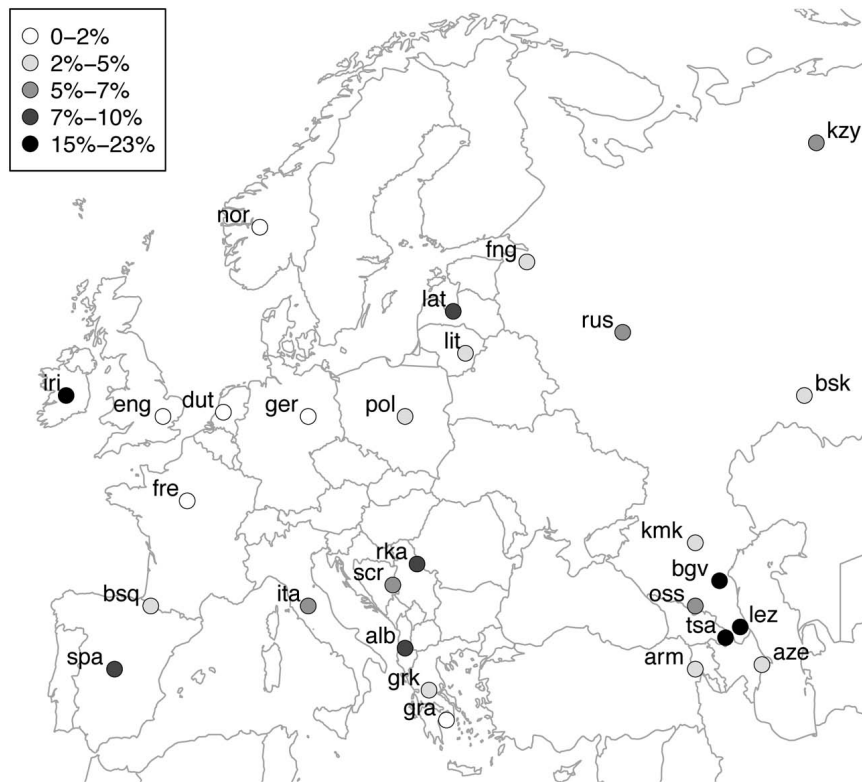


FIGURE 3 *The ratio of verbs with A and A&P locus in the languages of Europe*

Celtic languages show some resemblance to the Daghestanian languages with respect to argument encoding has been mentioned in the literature (Bossong, 1998: 263 with further reference to Heinrich Wagner). The distribution of the remaining languages is also generally similar to what is expected from previous studies. There are two more interesting points to make: (i) among the languages of western Europe, lower ratios of A locus are concentrated in the northern part, so the north-to-south dimension is discernible to almost the same extent as the often-mentioned west-to-east dimension; (ii) with respect to disfavoring A locus, the three Altaic languages are quite comparable to the languages of the SAE zone.³¹

ergative properties. It is not surprising, then, to find higher ratios of verbs with A locus of non-transitivity in these languages; see, e.g., Malchukov (2006: 343–345) for a principled account of the correlation between ergativity and manipulating A arguments.

31 An interesting hypothesis to study is whether there is a negative correlation between lex-

5.3 *Areal and Genetic Patterns in P Locus of Non-transitivity*

The discussion in the previous section can lead to the impression that the overall distribution of transitive and non-transitive valency frames in European languages, which was shown in Fig. 1, is wholly accounted for by the well-known prevalence of “nominative subjects” in the SAE area (roughly equivalent to disfavoring frames with A locus), and has nothing to do with the areal distribution of patterns with P-locus. The latter distribution can be seen in Fig. 4 (the relevant data are in Table 5 in the Appendix).

Similarly to some previous distributions, the usual west-to-east contrast is discernible in the data, with western European languages showing the lowest ratios of P locus. This means that high transitivity ratios in western Europe are in fact not accounted for exclusively by disfavoring A locus.

Apart from the east-to-west cline, further details in Fig. 4 are quite different from what was observed with respect to A locus. The highest concentration of P locus is found in the Circum-Baltic area and Ossetic. In western continental Europe, the lowest ratios of P locus are found in the south (Modern Greek, Spanish and Italian), that is, the pattern is quite the opposite of what was observed for A locus. All in all, these areal findings corroborate the conclusion put forward above that there is no significant positive correlation between frequencies of frames with A and P locus. What all these data imply is that the overall areal distribution of frequencies of transitives and non-transitives, as shown in Fig. 1 above, can be a result of superimposition of at least two relatively independent areal patterns.

5.4 *Areal and Genetic Patterns in Locus-based Profiles*

In surveying frequencies of valency frames defined in terms of locus, as with overall transitivity above, comparable ratios of verbs with the four types of locus in pairs of languages do not guarantee similarity between the sets of such verbs. Thus, again, it is useful to establish lexical “profiles” of individual

ical extent of A locus and the “strength” of the subject category. Intuitively, the data at hand do not contradict this expectation: cf. the very special “role-dominated” status of Celtic and Daghestanian among European languages as mentioned by Haspelmath (2001b: 55), Comrie’s (1981: 68) detailed argumentation for the idea that English is more subject-prominent than Russian, and Faarlund’s (1998) semi-quantitative three-way classification of 30 European languages, which generally fits the east-to-west dimension, so that the western European languages are claimed to possess “la plus forte catégorie subjectale” (ibid.: 186). Testing this hypothesis in its entirety is currently problematic due to the lack of quantitative techniques for measuring subject-prominence. See Witzlack-Makarevich (2011) for a large-scale proposal.

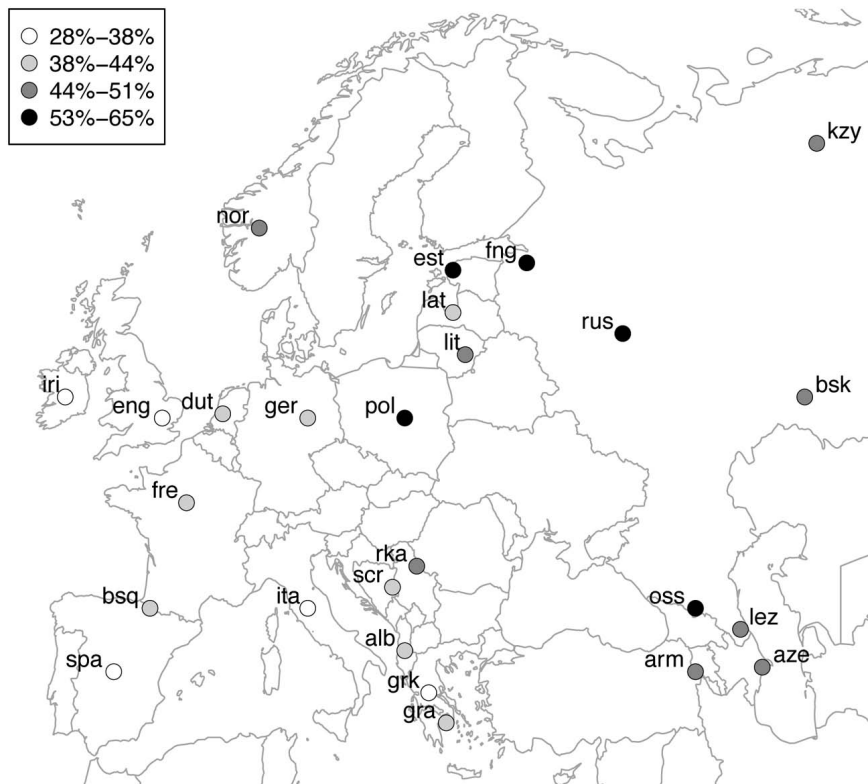


FIGURE 4 *The ratio of verbs with P locus in the languages of Europe*

languages, based on sets of predicates assigned to each of the four locus-defined types. It is possible to visualize emerging degrees of dissimilarity in the form of a splits graph, see Fig. 5 (in the same way as it was described in 4.2).

The data that are used for the graph in Fig. 5 are very similar to (but more elaborate than) the data that were used for the graph in Fig. 2 in Section 4.2. The new feature in the present data is the distinction between the three types of non-transitive frames (frames with A, P, and A&P locus of non-transitivity), whereas in 4.2., they were all collapsed. Not surprisingly, the overall pictures emerging from these two graphs are very similar.³² The main difference is that vast areal effects, which cut apart large sets of languages, are slightly

32 Notice that the typological similarity between Irish and the Daghestanian languages with respect to A locus, as discussed in 4.2., totally dissolves at the level of individual predicates. At the same time, the set of the three Daghestanian languages is internally quite homogeneous.

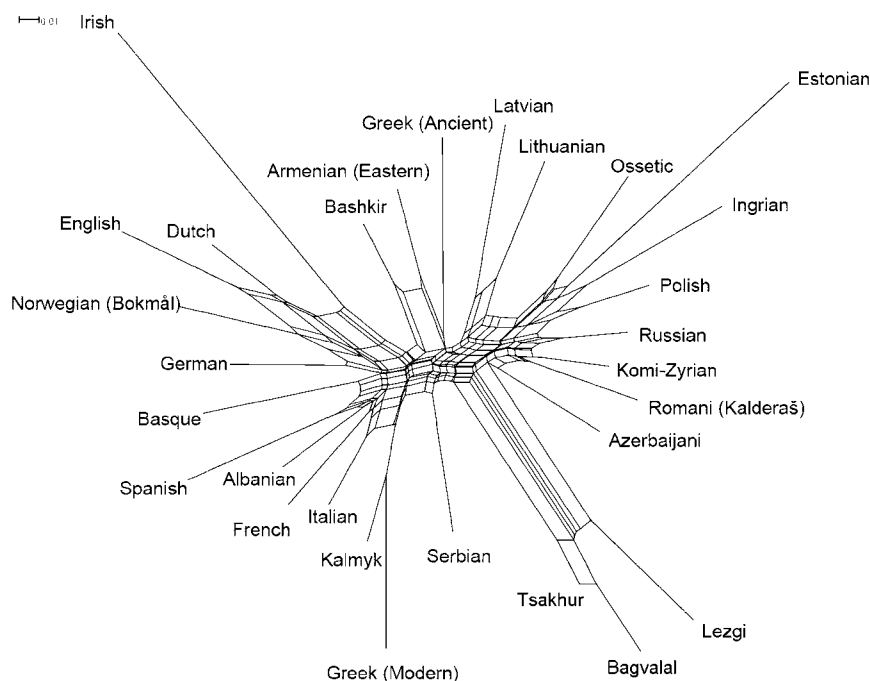


FIGURE 5 *(Dis)similarities in locus of marking deviations from canonical transitivity (NeighborNet visualization)*

less clearly seen (cf. the loss of a cluster that unites Modern Greek with the remaining highly transitive languages), whereas lower-level structures emerge more clearly, such as, e.g., associations between Basque and Spanish or Russian and Polish. Neither of these associations was seen in Fig. 2.

6 Complexity of Valency Class Systems

In this section I propose to measure complexity of valency class systems by way of calculating the entropy of the distribution of verbs among valency classes. High entropy values (more elaborate valency class systems) will be predictably found to dominate in eastern Europe, largely due to low transitivity ratios. Entropy of non-transitives alone will be shown to be weakly patterned areally.

Languages can differ with respect to complexity of their valency systems. To the extent that we maintain that valency frames are largely semantically motivated, languages with more complex valency class systems can be assumed to make finer distinctions between semantic roles of arguments, whereas less

complex systems tend to neutralize more of these distinctions, as argued by, e.g., Malchukov (2013).

The lexical range of transitives, as discussed above, is the clearest indicator of the degree of semantic non-discrimination between predicates. However, even beyond the transitive class, languages may differ in their propensity towards lumping vs. splitting verb-specific arguments. We thus need a technique for measuring this property of valency class systems.

One simple solution is to rely upon the number of valency classes into which the verbs are grouped. Technically, this can be easily implemented in our database (the relevant figures are in the “Classes” column of Table 5, see Appendix; notice the wide range of data, from 7 to 25 classes). Yet, this measure is particularly vulnerable to the vagaries of the data-gathering procedure, such as the number of verbs gathered³³ or particular decisions about how to categorize specific ambiguous verbs.

An alternative that will be used here is calculating entropy of the distribution of verbs among valency classes, according to the following formula.

$$(14) H(x) = - \sum_{i=1}^k p(x_i) \times \log(p(x_i))$$

In our case k is the number of valency classes in a given language and $p(x_i)$ is calculated as the ratio of the i th class of verbs relative to the overall number of verbs. The idea of calculating entropy is to measure the “amount of disorder” in a distribution. In a hypothetical language where all verbs belong to one class, entropy would equal zero. The theoretical maximum of entropy for a set of 130 items is $4.87 = \log(130)$; this would be observed in another hypothetical language, where each verb forms a class of its own. Real languages, of course, lie between these two extremes.

Entropy is lower for languages with fewer classes. With a given number of classes, maximal entropy is obtained if all classes are of equal size, whereas a system with one or a few large classes and many small classes would have lower entropy. For the sake of illustration, we can compare two hypothetical languages with 110 verbs that fall into 11 classes. In a language with class sizes (10, 10, 10, 10, 10, 10, 10, 10, 10, 10, 10) entropy would equal 2.40, whereas in a language with class sizes (100, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1) entropy would equal 0.51. Thus, other things being equal, languages with high transitivity ratios yield low entropy values, which reflects their lower degree of differentiation.

33 For this reason, the data for the four languages from which less than 100 verbs have been gathered are parenthesized in Table 5 (see Appendix).

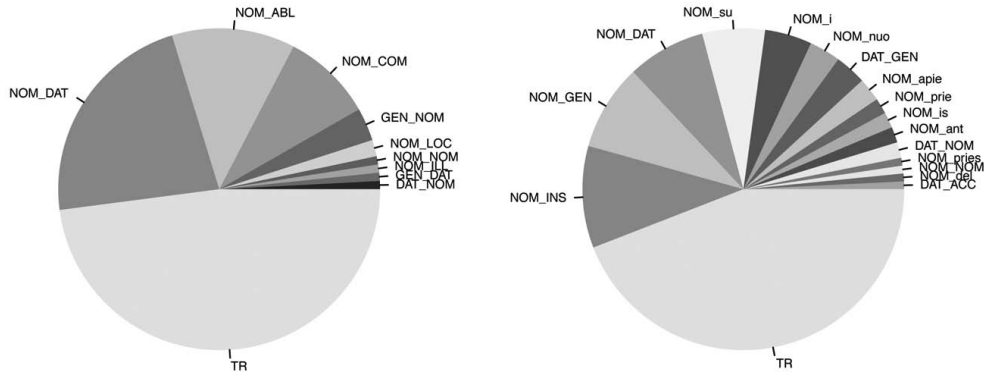


FIGURE 6 Valency classes in Azerbaijani (left) and Lithuanian (right)

In order to obtain an intuitive impression of how the entropy value is related to the structure of verb classes, we can compare the distributions of verbs into valency classes in Azerbaijani and Lithuanian. In Azerbaijani, the class sizes are (58, 27, 15, 11, 4, 2, 1, 1, 1, 1); that is, there are only ten classes, and the four biggest classes cover more than 90% of the verbs. The entropy equals 1.50 (a relatively low value), as calculated in (14a).

$$(14a) \quad H(\text{Azerbaijani}) = -\frac{58}{121} \times \log\left(\frac{58}{121}\right) - \frac{27}{121} \times \log\left(\frac{27}{121}\right) - \dots - \frac{1}{121} \times \log\left(\frac{1}{121}\right) = \\ -0.48 \times (-0.74) - 0.22 \times (-1.5) - \dots - 0.008 \times (-4.8) = 0.35 + \\ 0.33 + \dots + 0.04 = 1.50$$

In Lithuanian, there are 17 classes with sizes (56, 13, 11, 10, 8, 6, 4, 4, 3, 2, 2, 2, 2, 1, 1, 1, 1). The four biggest classes cover slightly above 70% of the verbs, and the transition from large to small valency classes is gentler than in Azerbaijani. Correspondingly, the entropy value is much higher: 2.05. A visual impression of the organization of valency classes in the two languages can be obtained from Fig. 6, where the distributions are displayed in the form of pie charts.

The geographical distribution of entropy values in the languages surveyed is shown in Fig. 7 (raw data can be found in Table 5 in the Appendix).

Entropy as such does not bring much new areal information (but it will be important for the discussion in Section 7): the areal pattern emerging from Fig. 7 is not surprising given the previous data discussed. As expected, higher values are observed for languages with lower transitivity ratios, that is, the two measures are inversely correlated. Modern Greek shows the most reduced system (high ratio of transitives, only 7 valency classes).

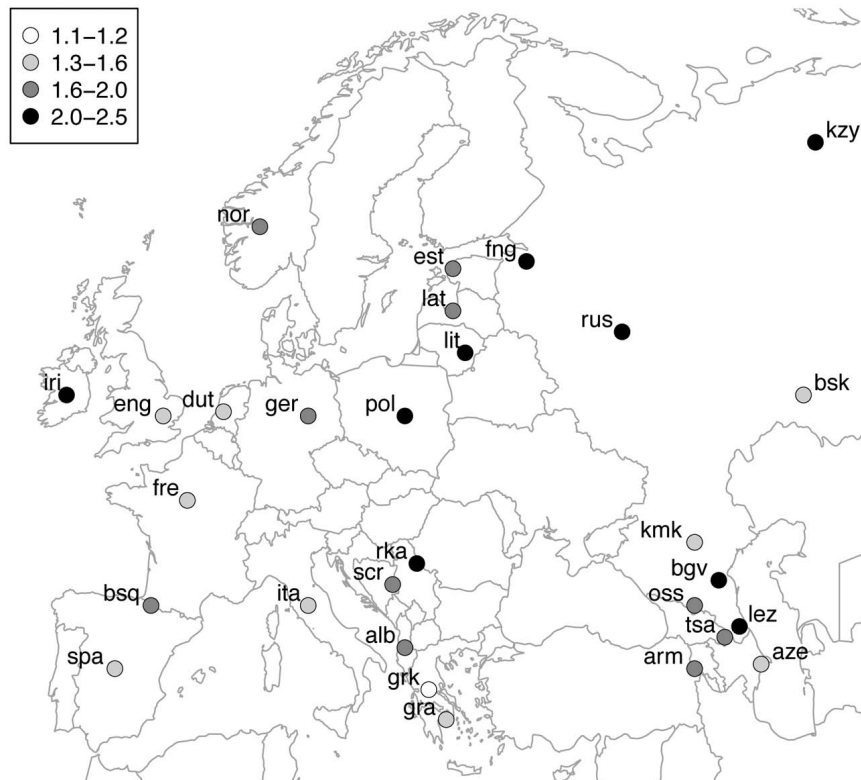


FIGURE 7 The entropy of verb class distributions in the languages of Europe

A more interesting picture emerges if one takes a closer look at distributions of non-transitive verbs only. In this case, entropy is analytically dependent upon the overall number of non-transitive verbs: languages for which 70 non-transitive verbs have been gathered would inevitably tend to show higher values than languages with, say, 50. It is more informative to consider what can be called *relative entropy* for non-transitive verbs, calculated as actual entropy divided by its theoretical maximum: $\log(N_{\text{intr}})$, where N_{intr} is the number of non-transitive verbs. This measure captures the relative elaborateness of the non-transitive class system. In Lithuanian, for instance, the relative entropy of non-transitives is rather high (57%), which reflects the gently sloping distribution of non-transitive classes. By contrast, in Azerbaijani, there are three large classes that cover 53 out of the total of 63 non-transitive verbs, and correspondingly the value of relative entropy of non-transitives for Azerbaijani is significantly lower, 38% (see Fig. 6 once again for a visual impression).

The values of relative entropy of non-transitive verbs are shown in the “ $H_{\text{intr}}/H_{\text{max}}$ ” column of Table 5 in the Appendix. Some peaks are expected from previous discussion (e.g., Irish and Daghestanian), but, in contrast to previously discussed measures, the geographic pattern is not quite as pronounced. In other words, internal organization of the non-transitive lexicon seems to be a more local phenomenon than most features discussed above (e.g., rather elaborate systems in German and Ingrian contrast with much more reduced systems in Dutch and Estonian, respectively).

The relative entropy expectedly correlates with the number of nominal cases (Pearson’s $r = 0.47$). By way of illustration, it can be noticed that all caseless languages of the sample (Romance, Dutch and Norwegian Bokmål) have low to moderate relative entropy values (47–53%), whereas languages with extremely large case inventories (15 or more cases), that is, Basque and especially Komi-Zyrian and the three Daghestanian languages, all have high relative entropy values (56–76%).

However, this correlation is not entirely straightforward. There seems to be a related but slightly different aspect of grammatical systems that is (also) at work here: the extent to which primarily spatial expressions (whether cases or adpositions) are recruited for coding argument relations. This can be illustrated for 12 languages of the sample with moderately large case inventories (5 to 9 cases), which are all spoken in Eastern Europe. In some of these languages (Slavic, Baltic and Kalderaš Romani) the ability to code both spatial relations and more abstract semantic relations is typical of many adpositions (which are prepositions in these languages), and all these languages have relative entropy above the population mean (53%). In the remaining 6 languages, which are spoken south of the Balto-Slavic area, relative entropy values are low (50% and less); here, the two functional domains are largely kept apart. In Turkic languages, Kalmyk, and Armenian, for instance, adpositions (which are postpositions in these languages) are, relatively speaking, weakly grammaticalized, and dependent-marking of arguments, at least for more abstract verbs, is monopolized by moderately rich case-marking (hence, low elaboration of non-transitive valency classes).

7 The Internal Structure of Valency Class Systems

This section is devoted to the objective of this study that poses the biggest methodological challenge: measuring (dis)similarities between languages based on the way predicates are arranged into individual valency classes. I propose a metric based on Mutual Information (MI), and ultimately on comparing

entropies of distributions. With the help of this metric I build a distance matrix for the languages of Europe. Its scrutiny reveals that the granularity of data in this case is finer than in the case of transitivity and locus of non-transitivity. Areally, this manifests itself in several local convergences (Basque and Romance; Irish and English; Eastern Armenian and Turkic languages). On a more theoretical level, these findings imply that valency class systems can assimilate in language contact, even if the devices that are employed for argument encoding differ drastically between the languages in contact.

In previous sections, measurement of pairwise (dis)similarities between languages was based on pre-established sets of discrete values, e.g. 'transitive' and 'non-transitive,' and on equating them, with some level of confidence, across languages. This enabled us to enquire whether a given predicate, e.g. 'lack,' shows the same value in a pair of languages, and consider positive or negative answers as indications of similarity or dissimilarity, respectively.

Such an approach proved useful when dealing with transitivity (two values, 4.2) and locus (four values, 5.4). However, once we differentiate further, we face a crucial problem: there seems to be no legitimate basis for equating individual valency classes across languages (several potential candidates, including descriptive grammatical labels, semantic roles and grammaticalization schemata, are discarded in Section 2).

Yet, intuitively, languages may be more or less similar in the ways they partition verbs into valency classes, that is, into classes of lower level than locus-based types. For capturing this intuition quantitatively, let's start with drawing a contingency table for a pair of languages, as shown in Table 4 for Eastern Armenian and Azerbaijani. The distribution of predicates into valency classes in these two languages is strikingly similar. Not only the transitive classes (see Table 2), but also major non-transitive classes can be nicely mapped from one language onto the other. For example, 7 out of 11 Azerbaijani verbs from the NOM_COM class correspond to verbs from the NOM_het class in Eastern Armenian; the reverse mapping rule has no exceptions at all. For the sake of readability, the best fitting classes in Table 4 are listed in corresponding order, which yields diagonal alignment of the largest values.³⁴

34 Identity of conventional labels of some classes is irrelevant and was not taken into account when analyzing the data. Also irrelevant were grammatical properties of individual constructions, e.g., whether cases, adpositions, or agreement markers are associated with individual classes in pairs of languages compared. The only aspect that matters in this approach is cross-linguistic (dis)similarity between classes defined in terms of predicates that fall into those classes.

TABLE 4 Correspondences between valency classes: Eastern Armenian vs. Azerbaijani

	TR	Azerbaijani									
		NOM_DAT	NOM_ABL	NOM_COM	GEN_NOM	NOM_ILL	NOM_IOC	DAT_NOM	GEN_DAT	NOM_NOM	
Eastern Armenian	TR	53	3	1	1	2	0	0	0	1	0
	NOM_DAT	1	16	0	0	0	0	0	0	0	0
	NOM_ABL	1	1	10	0	0	0	0	0	0	0
	NOM_het	0	0	0	7	0	0	0	0	0	0
	DAT_NOM	1	2	0	0	1	0	0	1	0	0
	NOM_NOM	1	1	0	0	0	1	0	0	0	1
	NOM_mej	0	0	0	0	0	0	1	0	0	0
	NOM_vra	0	3	3	0	0	0	0	0	0	0
	NOM_INS	0	0	0	3	0	0	0	0	0	0
	NOM_masin	1	0	1	0	0	0	0	0	0	0
	NOM_patcarov	0	1	0	0	0	0	0	0	0	0

Now, in order to capture the degree of similarity in pairs of valency class systems, I propose a technique based on mutual information (MI). MI is calculated as shown in (15), where X and Y are two probability distributions, $H(X)$ and $H(Y)$ are entropies of these distributions, and $H(X, Y)$ is the joint entropy.

$$(15) \text{MI}(X; Y) = H(X) + H(Y) - H(X, Y)$$

HAUSSER AND STRIMMER, 2009, via BICKEL, 2010

MI is calculated for Eastern Armenian and Azerbaijani in (16); notice that joint entropy is calculated based on the distribution of predicates among *all* available correspondence classes (cells in the two-dimensional table), which is viewed as a one-dimensional distribution. In the case of Eastern Armenian and Azerbaijani, there are 110 (= 11×10) cells. Out of these 110 cells, 27 are non-empty, that is, contain values that add to the joint entropy; raw frequencies are (53, 3, 1, 1, 2, 1, 1, 16 ... 1) in this case. The diagonal alignment of the data in Table 4 is irrelevant for calculations, it was employed for visualization purposes only.

$$(16) \text{ MI (Eastern Armenian; Azerbaijani) } = 1.66 + 1.46 - 2.20 = 0.92.^{35}$$

MI is a symmetric measure that captures the degree of similarity between two distributions. If there were an exceptionless one-to-one correspondence rule for valency classes in two hypothetical languages, then the two distributions would be mutually maximally informative (MI would equal entropies in both distributions and in the joint distribution, all identical). If two distributions had no similarity, then their joint entropy would be equal to the sum of entropy values in the two distributions and MI would equal zero. The real picture for Eastern Armenian and Azerbaijani is naturally somewhere in between.

MI as such is not suitable for measuring similarities in heterogeneous samples of languages because it is biased in favor of languages with higher entropy values (pairs of more complex systems are expected to yield higher MI values than more reduced systems). Thus, for building a distance matrix, we need to normalize MI. This can be done by way of calculating *predictability*. The formula for calculating the predictability of X given Y is shown in (17).

$$(17) \pi(X|Y) = \frac{MI(X,Y)}{H(x)}$$

HAUSSER AND STRIMMER, 2009, via BICKEL, 2010

Predictability values vary between 0 (the two distributions are unrelated) to 1 (the distribution that is given can be unequivocally mapped onto the distribution being predicted). Real values for our data are again somewhere in between, e.g., $\pi(\text{Eastern Armenian}|\text{Azerbaijani}) = \frac{0.92}{1.66} = 0.56$, and $\pi(\text{Azerbaijani}|\text{Eastern Armenian}) = \frac{0.92}{1.46} = 0.63$.

Predictability is an asymmetrical measure: the distribution with lower entropy is always easier to predict, given the distribution with higher entropy, than the other way around. With respect to valency classes, this means that correspondence rules from more elaborate systems to simpler systems are more efficient than correspondence rules in the opposite direction. For our purposes, directionality of correspondence rules is irrelevant. I propose to calculate a distance measure D as shown in (18):

$$(18) D(X, Y) = 1 - \frac{\pi(X|Y) + \pi(Y|X)}{2}$$

35 The entropy values are slightly different from the figures shown in the Appendix because only those predicates that were obtained for both languages are taken into account here.

For Azerbaijani and Eastern Armenian, $D = 1 - \frac{0.56+0.63}{2} = 0.41$. Defined in this way, D varies between 0 (hypothetical pairs of languages with identical distributions of predicates among valency classes) to 1 (hypothetical pairs of languages with no correspondence between valency classes above chance probabilities). D is a *metric*: it equals zero if and only if the two distributions are identical, it is non-negative, symmetric and meets the requirement of subadditivity (triangle inequality).

Proposing this measure is the main methodological result of this study. Its main advantage is that it captures similarities between valency classes of predicates, regardless of the language-specific grammatical properties of valency constructions. For example, if languages L_1 and L_2 have identical valency class systems (that is, there is a one-to-one correspondence between classes in terms of predicates entering these classes), their D would equal 0, even if, e.g., L_1 is dependent-marking and L_2 is head-marking, or if L_1 is accusative and L_2 is ergative. No less important is the fact that D does not require particular classes to be singled out as transitive classes in the languages being compared. This is also a big advantage, because for some languages identification of the transitive class is far from trivial.

We can now build a distance matrix based on the D measure for our sample of languages. Similarly to what was described in Sections 4.2 and 5.4, these distances are plotted in a splits graph, visualized by the NeighborNet algorithm in Fig. 8.

By and large, there is less structure in Fig. 8 than in Figs 2 and 5 above (which show distances based on transitivity and locus, respectively). The longer edges that set apart individual languages in Fig. 8 reflect the huge number of available possibilities for grouping verbs into classes, so that each language appears to solve the problem in a quite unique fashion.

If compared to Figs 2 and 5 above, Fig. 8 is more indicative of local areal and low-level genetic similarities, probably at the expense of large-scale areal patterns. For some languages there is no areally or genetically interpretable signal in the data at all, as is the case with Kalmyk, Modern Greek and Estonian: whatever the typological reasons for their closeness in the splits graph, it cannot be attributed to their historical development or areal proximity. Probably, a tighter grid of languages is needed for finding non-accidental similarities for a larger number of languages.

However, on a lower level, Fig. 8 is indicative of some genetic groupings—Baltic, Daghestanian (both also present in Figs 2 and 5), and Germanic (Fig. 8 shows a split that separates the Germanic languages from all other languages, which was not the case with Figs 2 and 5). It is even more indicative of individual areal convergences: Basque and the three Romance languages; Irish

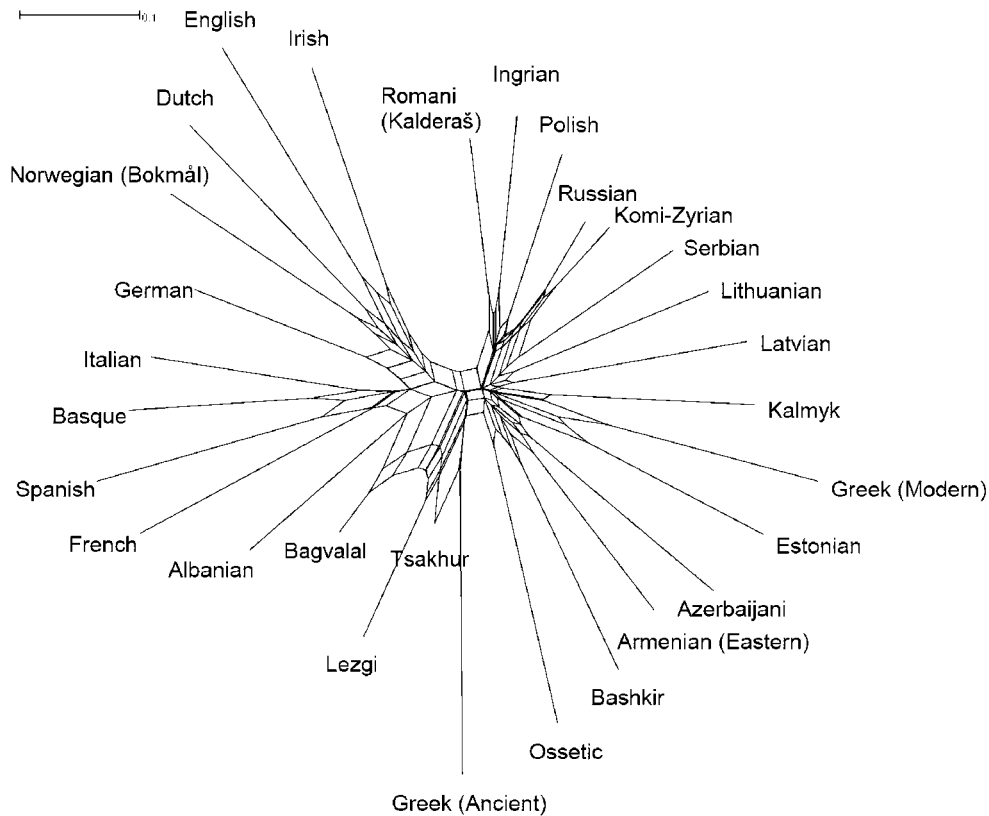


FIGURE 8 (Dis)similarities between the languages of Europe based on pairwise mutual predictability of valency class membership (NeighborNet visualization)

and English; Eastern Armenian and the two Turkic languages; and finally a group encompassing Polish, Russian and three languages in heavy contact with Russian: Komi-Zyrian, Kalderaš Romani (see fn. 18) and Ingrian. Presumably these convergences are accounted for by contact-induced phenomena, such as calquing valency frames of individual lexical items or contact-induced grammaticalization of argument-coding devices.

The usual problem with quantitative generalizations based on relatively large samples is that, in order to interpret them linguistically, we have to go back to the data and scrutinize individual results, e.g., track pathways of development that yielded lexical similarities between individual classes in Eastern Armenian and Azerbaijani, as shown in Table 4 above. Moreover, the groupings present in Fig. 8 cannot be viewed as straightforwardly indicative of actual language contact. We know, for instance, that Basque has had contact with

Spanish and French, but not Italian, and that Ingrian is heavily dominated by Russian, but not in contact with Polish; but this knowledge cannot be inferred from the data in Fig. 8. Nevertheless, we can observe that, with respect to internal organization of valency class systems, a genetically unrelated language can cluster with a group that consists of genetically closely related languages. This fact implies that assignment of verbs to valency classes is a grammatical property that can undergo assimilation in language contact despite non-identity of techniques of argument-marking, which are often not easily transferrable.

8 Conclusions

The analysis of valency class systems in the preceding sections forms a four-step cascade: transitivity, locus of marking deviations from transitivity, overall elaborateness of valency class systems, and the ways in which verbs are grouped into individual valency class systems. In other words, we moved from more basic and coarse distinctions among bivalent verbs to more subtle aspects of the organization of the verb lexicon.

The data in each of the four cases were taken from the same database, so that individual sections differed primarily in the perspective taken. It is not surprising, then, that the areal patterns established in the individual sections are largely consonant.

There are, however, important differences, too. Indeed, with transitivity the methodology is rather simple and the results converge to a large-scale areal pattern: the transitive class is most extensive in Romance, Germanic, Basque and some Balkan languages—a grouping close to what is commonly assumed to be the Standard Average European core—whereas many peripheral European languages are “less transitive.” A very interesting point for further research is to place the European pattern just described into a wider, ideally world-wide, perspective. It is worth noting in passing that the lexical range of transitivity among bivalent verbs deserves being included in the list of common typological parameters, something that does not seem to have happened yet, despite some previous appeals (Drossard, 1991).³⁶

³⁶ The well-known parameter of “valence orientation” (Nichols et al., 2004) might come close, but, logically at least, it is independent of what is explored here: it is concerned with derivational relations between transitive and intransitive verbs, not with the bivalent verbs’ probabilities of being transitive. The two parameters are similar in that both are related to what is basic in the lexicon of a given language, transitive or non-transitive.

Once we go one step down the cascade, the clear areal picture starts to blur: marking non-transitivity by putting the A argument into an oblique position is particularly typical of Irish and Daghestanian languages, whereas the highest ratios of verbs with P locus are found in the languages of the Circum-Baltic area. Thus, the SAE-like areal pattern with respect to transitivity results from a superimposition (or a conspiracy?) of at least two relatively independent distributions.

The finding that the areal patterns related to the distribution of A and P locus are relatively independent is not surprising. Unlike transitivity, abstract “non-transitivity” for two-place predicates is an umbrella term covering phenomena which have nothing positive in common: transitive verbs are all alike, every non-transitive verb is non-transitive in its own way (cf. Malchukov, 2005: 80). If we assume that large-scale areal patterns are not coincidental, we have to reconstruct or at least model the mechanisms by which relevant properties spread among languages. It is clear that properties related to valency cannot be inherited or assimilated in contact without affecting individual verbs. It is only natural, then, that there is no breeding ground of abstract “non-transitivity” in Europe: it is hard to imagine a mechanism of transmitting non-transitivity as such without transmitting something more specific, like, e.g., the locus of non-transitivity.

Finally, at the level of individual valency classes, large-scale areal trends become even less palpable. This is partly due to the fact that it was impossible to propose a simple and tangible measure that would nevertheless capture the subtleties of internal structure of the verbal lexicon. In fact, developing a technique that can be used for measuring dissimilarities between valency class systems is a tricky task; the proposal made in Section 7 is thus the methodological climax of this study. Notice that this technique is based on calculating entropy and mutual information, and does not rely upon *a priori* identification of the transitive class (a procedure that can be methodologically vulnerable).

As already mentioned, when going down to the level of organization of individual classes, we lose the distinctness of large-scale areal patterns. We gain, however, in tracking numerous low-level convergences between languages, both genetic (Daghestanian, Germanic, Baltic and, to a lesser extent, Romance, Turkic and Slavic are groupings that are discernible in the data) and exclusively areal (Irish and English, Basque and Romance, Eastern Armenian and Turkic, and a group of languages heavily influenced by Russian). This is one of the main findings of the study: lexical distributions of (non-)transitivity display similarities in vast geographical zones, whereas similarities between valency class distributions emerge on a much more local level.

What is particularly striking is that, when valency class systems show local convergences, the areal signal in the data can be as significant as the genetic signal. The areal signal is present in at least the following groupings that were detected when visualizing the distance matrix: Basque and the Romance languages; Irish and English; Eastern Armenian and Turkic; Russian and several languages in contact with, and dominated by, Russian, namely Ingrian, Komi-Zyrian and Romani Kalderaš (its variety spoken near St. Petersburg).

What these findings imply is that the organization of valency classes can be assimilated in language contact. More importantly, organization of the lexicon in terms of valency classes can develop more or less independently of individual devices that are employed for coding arguments. Several facts observed in the study are particularly illustrative in this respect.

One example is the position of Basque: in *all* aspects discussed above, Basque patterns similarly to surrounding Romance languages. With respect to lexical distribution of (in)transitivity, it also fits the general western European pattern. Notice that in most respects discussed in “Eurolinguistics,” Basque is not considered typically European (Heine and Kuteva, 2006: 7). What the present study shows is that a significant degree of similarity in the structure of the verbal lexicon is maintained, despite drastic differences in alignment, case inventories and argument-marking techniques in general.

Another example is the relative position of Ancient and Modern Greek. The argument-coding techniques in these two languages are very similar: there was only one case opposition that was lost in the course of historic development, all prepositions that are employed for coding arguments in Modern Greek correspond to Ancient Greek cognates that also were involved in coding arguments; even the verbs in the database are etymologically related in many cases. And yet, Ancient and Modern Greek do not pattern together in *any* of the splits graphs above. This means that the system of bivalent classes in Greek has significantly changed despite preservation of argument-marking devices. On a more general level, this finding indicates that valency classes can change faster than the inventory of morphosyntactic devices of argument coding.

If this is true, we have to face an important theoretical challenge. Much of the study in the field of lexical typology is based on a tacit assumption that lexical profiles of languages are somehow dependent upon their grammatical profiles. In terms of areal and genetic mechanisms of transfer it is necessary to consider the opposite: the possibility that grammatical patterns are largely shaped by properties of the lexicon (Nichols et al., 2004).

Abbreviations

3	third person	INACT	inactive
ABS	absolutive	M	masculine
ACC	accusative	NOM	nominative
ACT	active	PL	plural
ART	article	POSTEL	postelative
DAT	dative	PRO	pronoun
DEF	definite	PRS	present
F	feminine	PST	past
GEN	genitive	SG	singular
IMPF	imperfective		

Acknowledgments

The study reported here was supported by a grant from the Russian Foundation for Humanities, No. 11-04-00179a “Verb argument structure variation and verb classification in languages of various structural types.” This paper would have been impossible without the help of fellow participants of this project. The names of those colleagues who have gathered data for individual languages are listed in Table 1; I am also indebted to all of them for useful theoretical suggestions that emerged when discussing data from respective languages or otherwise. I am immensely grateful to Andrej Malchukov, Johanna Nichols, Alexander Rusakov, Alena Witzlack-Makarevich and three anonymous reviewers for comments on earlier version of this paper that helped to improve it. I am indebted to Maria Kholodilova for writing a macro in Visual Basic that significantly reduced time-consumption on computational tasks. I profited a lot from discussions with Balthasar Bickel and Alena Witzlack-Makarevich during my short-term stay at the University of Zurich. I thank the audiences at the KNAW Conference “Patterns of Diversification and Contact” in Amsterdam and the “Phylogenetic and Phylogenetic Approaches in the Humanities” workshop in Bern for their helpful questions on earlier versions of this study and for sharing their inspiration. Finally, I am grateful to Maria Ovsjannikova who created maps for this paper using R and offered her comments at various stages of writing. None of the kind people mentioned here bears any responsibility for possible errors and shortcomings of this paper.

References

- Aikhenvald, Alexandra Y., Robert M.W. Dixon, and Masayuki Onishi (eds.). 2001. *Non-canonical Marking of Subjects and Objects*. Amsterdam: John Benjamins.
- Apresjan, Yurij D. 1967. *Eksperimentalnoe issledovanie semantiki russkogo glagola*. Moskva: Nauka.
- Barðdal, Jóhanna. 2014. Syntax and syntactic reconstruction. In Claire Bower and Bethwyn Evans (eds.), *The Routledge Handbook of Historical Linguistics*. London: Routledge.
- Bickel, Balthasar. 2010. Quantitative methods in typology. Course taught at the DGF-CNRS Summer School on Linguistic Typology, Leipzig, August 15–27. Available at <http://www.uni-leipzig.de/~bickel/lehre/Leipzig2010/> (accessed March 21, 2014).
- Bickel, Balthasar, Taras Zakharko, Lennart Bierkandt, and Alena Witzlack-Makarevich. In prep. Semantic role clustering: An empirical assessment of semantic role types in non-default case assignment. To appear in *Studies in Language*. Downloadable at www.spw.uzh.ch/bickel-files/papers/Semantic_roles_accepted.pdf (accessed March 21, 2014).
- Bossong, Georg. 1998. Le marquage de l'expérient dans les langues d'Europe. In Feuillet (ed.), 259–294.
- Comrie, Bernard. 1981. *Language Universals and Linguistic Typology: Syntax and Morphology*. Oxford: Blackwell.
- Comrie, Bernard. 1993. Argument structure. In Joachim Jacobs, Arnim von Stechow, Wolfgang Sternefeld, and Theo Vennemann (eds.), *Syntax: An International Handbook of Contemporary Research*, Vol. 1, 905–914. Berlin: Mouton de Gruyter.
- Comrie, Bernard and Andrej Malchukov (eds.). Forthcoming. *Valency Classes: A Comparative Handbook*. Berlin: Mouton de Gruyter.
- Dixon, Robert M.W. and Alexandra Y. Aikhenvald (eds.). 2000. *Changing Valency: Case Studies in Transitivity*. Cambridge: Cambridge University Press.
- Dowty, David. 1991. Thematic proto-roles and argument selection. *Language* 67: 547–619.
- Drossard, Werner. 1991. Transitivität (vs. Intransitivität) und Transitivierung (vs. Intransitivierung) unter typologischem Aspekt. In Hansjakob Seiler and Waldfried Premper (eds.), *Partizipation: Das sprachliche Erfassen von Sachverhalten*, 408–445. Tübingen: Narr.
- Faarlund, Jan Terje. 1998. Symetrie et dissymetrie des actants centraux. In Feuillet (ed.), 147–192.
- Feuillet, Jack (ed.). 1998. *Actance et valence dans les langues de l'Europe*. Berlin: Mouton de Gruyter.
- Ganenkov, Dmitrij. 2002. Modeli polisemii prostranstvennyx pokazatelej. Unpublished ms., Moscow State University.

- Graffelman, Jan. 2006. A guide to biplot calibration. Unpublished ms.
- Hagège, Claude. 2010. *Adpositions*. Oxford: Oxford University Press.
- Haspelmath, Martin. 1998. How young is Standard Average European? *Language Sciences* 20: 271–287.
- Haspelmath, Martin. 2001a. The European linguistic area: Standard Average European. In Martin Haspelmath, Ekkehard König, Wolfgang Oesterreicher, and Wolfgang Raible (eds.), *Language Typology and Language Universals: An International Handbook*, 1492–1510. Berlin/New York: Walter de Gruyter.
- Haspelmath, Martin. 2001b. Non-canonical marking of core arguments in European languages. In Aikhenvald et al. (eds.), 53–83.
- Haspelmath, Martin. 2010. Comparative concepts and descriptive categories in cross-linguistic studies. *Language* 86(3): 663–687.
- Haspelmath, Martin. 2011. On S, A, P, T, and R as comparative concepts for alignment typology. *Linguistic Typology* 15(3): 535–567.
- Haspelmath, Martin, Matthew S. Dryer, David Gil, and Bernard Comrie (eds.). 2005. *The World Atlas of Language Structures*. Oxford: Oxford University Press.
- Hausser, Jean and Korbinian Strimmer. 2009. Entropy inference and the James-Stein estimator, with application to nonlinear gene association networks. *Journal of Machine Learning Research* 10: 1469–1484.
- Heine, Bernd and Tania Kuteva. 2006. *The Changing Languages of Europe*. Oxford: Oxford University Press.
- Hopper, Paul J. and Sandra A. Thompson. 1980. Transitivity in grammar and discourse. *Language* 56: 251–299.
- Huson, Daniel H. and David Bryant. 2006. Application of phylogenetic networks in evolutionary studies. *Molecular Biology and Evolution* 23: 254–267.
- Kibrik, Aleksandr E. (ed.). 1999. *Elementy tsaxurskogo jazyka v tipologicheskom osveshchenii*. Moskva: Nasledie.
- Kibrik, Aleksandr E. (ed.). 2001. *Bagvalinskij jazyk: grammatika, teksty, slovari*. Moskva: Nasledie.
- Kittilä, Seppo. 2002. *Transitivity: Towards a Comprehensive Typology*. Turku: Åbo Akademi Tryckeri.
- Lazard, Gilbert. 1994. *L'actance*. Paris: Presses Universitaire de France.
- Lazard, Gilbert. 1998. Définition des actants dans les langues européennes. In Feuillet (ed.), 11–146.
- Levin, Beth. 1993. *English Verb Classes and Alternations*. Chicago: University of Chicago Press.
- Luraghi, Silvia. 1991. Paradigm size, possible syncretism, and the use of adpositions with cases in flective languages. In Frans Plank (ed.), *Paradigms: The Economy of Inflection*, 57–74. Berlin: Mouton de Gruyter.
- Malchukov, Andrej L. 2005. Case pattern splits, verb types and construction competi-

- tion. In Mengistu Amberber and Helen de Hoop (eds.), *Competition and Variation in Natural Languages: The Case for Case*, 73–117. London/New York: Elsevier.
- Malchukov, Andrej L. 2006. Transitivity parameters and transitivity alternations: Constraining co-variation. In Leonid Kulikov, Andrej Malchukov, and Peter de Swart (eds.), *Case, Valency and Transitivity*, 329–357. Amsterdam, Philadelphia: John Benjamins.
- Malchukov, Andrej L. 2013. Valency classes cross-linguistically: Parameters of variation. Paper presented at the workshop “Valency classes in the world’s languages,” MPI EVA, Leipzig, August 14–15, 2013.
- Næss, Åshild. 2007. *Prototypical Transitivity*. Amsterdam/Philadelphia: John Benjamins.
- Nichols, Johanna, David A. Peterson, and Jonathan Barnes. 2004. Transitivity and detransitivizing languages. *Linguistic Typology* 8: 149–211.
- Onishi, Masayuki. 2001. Introduction: Non-canonically marked subjects and objects: Parameters and properties. In Aikhenvald et al. (eds.), 1–51.
- R Core Team. 2013. R: A language and environment for statistical computing. Vienna: R Foundation for Statistical Computing. Downloadable at <http://www.r-project.org/> (accessed March 21, 2014).
- South, Andy. 2011. rworldmap: A new R package for mapping global data. *The R Journal* 3/1, 35–43.
- Stassen, Leon. 2009. *Predicative Possession*. Oxford: Oxford University Press.
- Tsunoda, Tasaku. 1981. Split case-marking patterns in verb-types and tense/aspect/mood. *Linguistics* 19: 389–438.
- Van Belle, William and Willy van Langendonck (eds.). 1996. *The Dative*. Amsterdam/Philadelphia: John Benjamins.
- Van der Auwera, Johan. 2011. Standard Average European. In Bernd Kortmann and Johan van der Auwera (eds.), *The Languages and Linguistics of Europe*, 291–306. Berlin: Mouton de Gruyter.
- Wierzbicka, Anna. 1983. The semantics of case marking. *Studies in Language* 7 (2): 247–275.
- Witzlack-Makarevich, Alena. 2011. *Typological Variation in Grammatical Relations*. PhD dissertation, University of Leipzig.

Appendix

TABLE 5 *Basic valency-related parameters. N is the number of predicates for which the valency pattern has been identified. The next four columns contain percentages of transitive and three types of non-transitive classes (with A locus, P locus and A&P locus). "Classes" indicates the number of valency classes. H stands for overall entropy of the distribution among valency classes, and H_{intr}/H_{max} for the relative entropy of the distribution of non-transitive verbs (that is, actual entropy of non-transitive classes divided by its theoretical maximum, the natural logarithm of the number of non-transitive verbs). The last column represents the number of morphological cases.*

	N	Transitivity and locus				Complexity			Cases
		Tr	A	P	A&P	Classes	H	H_{intr}/H_{max}	
Albanian	128	52%	7%	40%	1%	14	1.67	50%	5
Armenian (Eastern)	127	50%	5%	46%	0%	11	1.69	48%	5
Azerbaijani	121	48%	4%	47%	1%	10	1.50	38%	6
Bagvalal	65	(45%)	(22%)	(34%)	(0%)	(21)	2.20	76%	19
Bashkir	113	46%	5%	49%	0%	11	1.59	40%	6
Basque	116	56%	3%	41%	0%	16	1.65	56%	16
Dutch	116	61%	0%	39%	0%	11	1.41	50%	0
English	122	63%	0%	37%	0%	12	1.37	51%	2
Estonian	89	(34%)	(2%)	(64%)	(0%)	(9)	1.66	38%	14
French	124	56%	2%	41%	0%	11	1.54	49%	0
German	127	55%	2%	43%	0%	19	1.84	63%	4
Greek (Ancient)	121	55%	2%	42%	0%	12	1.38	39%	4
Greek (Modern)	127	67%	5%	28%	0%	7	1.11	39%	3
Ingrian	116	38%	3%	58%	2%	17	2.07	53%	13
Irish	119	43%	8%	36%	13%	25	2.11	59%	2
Italian	118	58%	6%	36%	0%	8	1.43	47%	0
Kalmyk	98	(59%)	(4%)	(37%)	(0%)	(9)	1.42	50%	9
Komi-Zyrian	119	45%	7%	49%	0%	19	2.10	61%	16
Latvian	105	50%	5%	43%	3%	12	1.77	54%	5
Lezgi	116	34%	14%	48%	3%	24	2.43	63%	18
Lithuanian	127	44%	2%	50%	3%	17	2.05	57%	6
Norwegian Bokmål	123	54%	1%	46%	0%	16	1.69	53%	0
Ossetic	116	39%	6%	55%	0%	14	1.94	49%	9
Polish	128	42%	3%	53%	2%	17	2.18	60%	6
Romani (Kalderaš)	120	41%	8%	50%	2%	16	2.06	55%	7
Russian	130	42%	4%	53%	2%	23	2.27	63%	6

	N	Transitivity and locus				Complexity			Cases
		Tr	A	P	A&P	Classes	H	H_{intr}/H_{max}	
Serbian	123	50%	6%	44%	1%	20	1.98	62%	5
Spanish	123	59%	8%	33%	0%	10	1.45	47%	0
Tsakhur	55	(55%)	(15%)	(31%)	(0%)	(14)	1.81	76%	17
Mean		50%	5%	44%	1%	15	1.77	53%	